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A Genus Hybrid—Maize and Tripsacum

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A DISTANT RELATIVE OF MAIZE

Frontispiece

Pistillate spikelets of Tripsacum, a wild relative of maize. The silks are less than an inch long and are divided. The seed is embedded in an indurated shell consisting of the rachis and the outer glume. Enlarged 4.7 times.

HYBRIDIZATION OF MAIZE, TRIPSACUM, AND EUCHLAENA

P. C. MANGELSDORF and R. G. REEVES
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THE tribe Tripsaceae (Maydeae) is represented in America by three genera, Zea, Euchlaena, and Tripsacum. The first includes but one species, *Zea mays,* the well known and widely grown Indian corn.

Euchlaena, commonly known as teosinte, comprises at least two species. Annual teosinte, *Euchlaena mexicana,* is a plant which, when first discovered, was thought to be the prototype of maize, later considered as one of the parents of the hypothetical hybrid from which maize was supposed to have originated, and is now regarded by some as merely a closely related species, perhaps descending with maize from a common ancestor. It was formerly grown, and still is to some slight extent, as a soiling crop in the Southern states, though even for this purpose it has been largely replaced by other crops. Asa Gray's hope that teosinte is a plant "possibly affording an opportunity for one to make millions of blades of grass grow where none of any account grew before"* has not been realized.

Perennial teosinte, *Euchlaena perennis,* like the annual form, is native to Mexico, from where it was introduced into this country some years ago by Collins.[3] As a crop plant it has even less value than annual teosinte but it has proven very valuable for certain genetic and cytological studies.

Tripsacum, the third American genus of this tribe, is represented by six or seven species. Three of these, *T. dactyloides, T. floridanum, and T. lemmoni,* are indigenous to the United States while the others are found in tropical America. *T. dactyloides* is the most common species in the United States where it occurs naturally in moist places throughout the eastern half of the country, extending as far west as Kansas and Texas, and north to Connecticut. It has never been grown as a crop plant though several botanists, in the past, have suggested its possible value as a forage crop.

Previous Crossing Experiments

Both species of Euchlaena are fairly closely related to maize. They can be readily crossed with the latter and produce fertile or partially fertile hybrids. Their chromosomes are at least partially homologous with those of maize, as shown by the genetic studies of Emerson[7] and the cytological observations of Longley[11] and Randolph.†

Tripsacum, on the other hand, is generally regarded as being much less closely related to maize. Weatherwax,[13] for example, states: "Except for monoecism this genus resembles some of the Andropogoneae, such as Manisuris, much more than the other Maydeae." Collins,[3a] in a recent paper which has just come to hand, expresses a similar opinion in different language. He states: "The relationship between *Tripsacum* and *Zea* is remote and the chief reason for introducing *Tripsacum* into a discussion of the phylogeny of maize is that *Tripsacum* is the only American representative of the group of grasses to which *Euchlaena* and *Zea* belong, that is found growing outside of cultivated areas."

Tripsacum does not cross naturally with maize. Neither natural nor artificial hybrids of these genera have ever

*Quoted by Lamson-Scribner, *U. S. D. A. Farmers' Bull.,* No. 102.
†Unpublished, cited by Emerson.[7]

TRIPSACUM FROM TEXAS AND CONNECTICUT

Figure 1

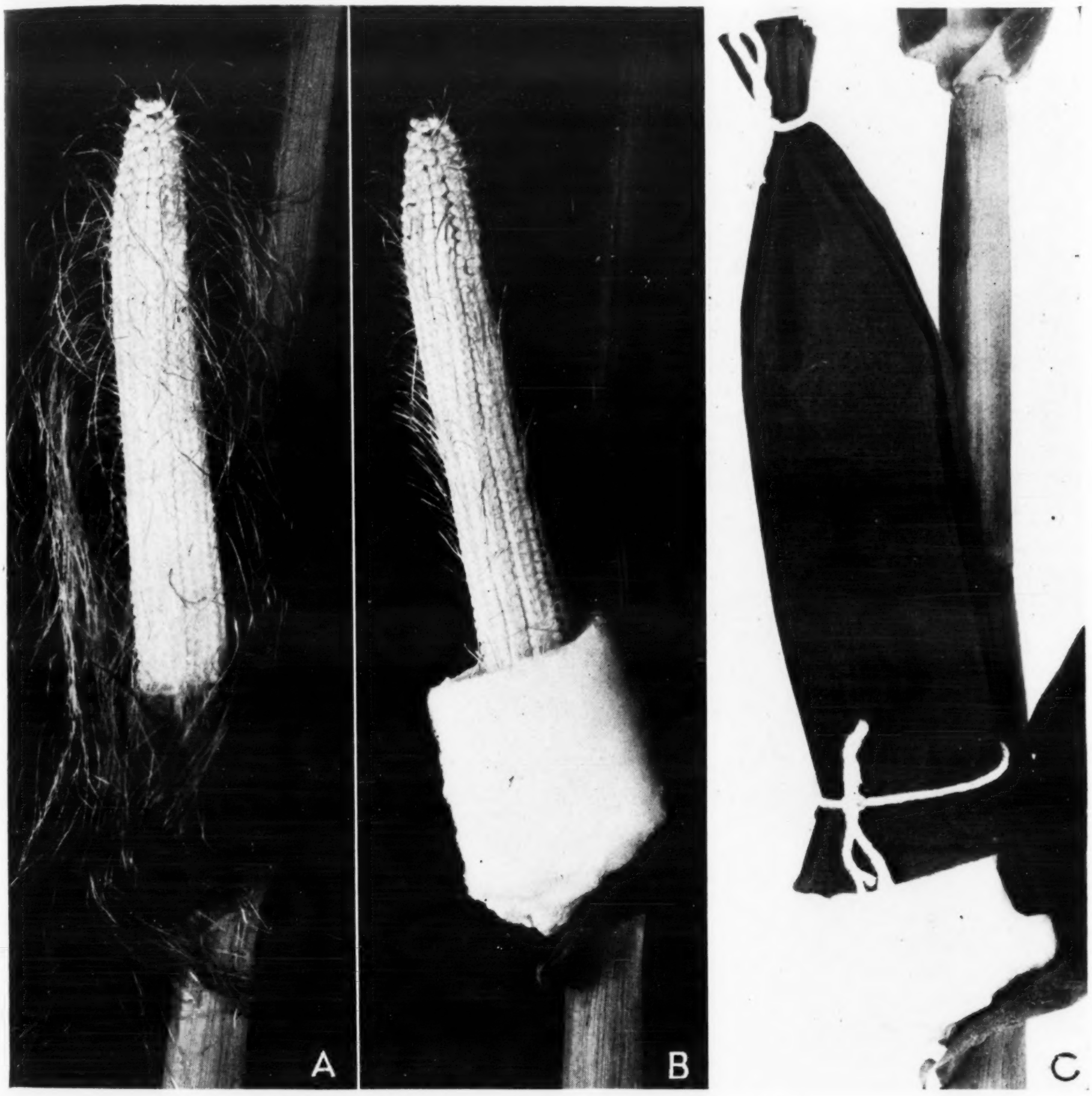
The Texas form (left) has narrower, stiffer, and more erect leaves than the Connecticut form (right). The somatic chromosome numbers are 36 and 72, respectively.

been previously recorded, with the possible exception of some "false" hybrids reported by Collins and Kempton.[4] These writers attempted to hybridize Tripsacum with both Zea and Euchlaena. Their cross of Tripsacum × Zea produced only matroclinous plants, presumably the result of parthenogenetic development of the Tripsacum ovule. The cross Tripsacum × Euchlaena was even more surprising for it gave rise to a single plant which proved to be pure Euchlaena like the pollen parent, a condition for which they suggested the term "patrogenesis."

Parthenogenesis as a Means of Improvement

These results are important from several standpoints. The patroclinous plant from the cross Tripsacum × Euchlaena presumably originated through the development of a sporophyte from a male gamete and is one of the few recorded instances of this phenomenon. The matroclinous plants from the cross Tripsacum × Zea indicate that the female gametes also are capable of parthenogenetic development. The occurrence of these two types of parthenogenesis in two genera related to maize, one quite closely related, suggests some slight possibility of developing homozygous strains of maize through parthenogenesis as a substitute for prolonged inbreeding. This would be very important from the standpoint of crop improvement, both in saving time and labor, as East[6] has recently pointed out, and in greatly increasing the opportunities of isolating extremely favorable combinations of genes because selection involves the gametes rather than the zygotes.

The relative efficiency of gametic selection and zygotic selection can be



CROSSING MAIZE WITH TRIPSACUM

Figure 2

The husks are removed and the long silks are cut off to an inch or less in length. After pollination, an artificial shuck is provided to prevent contamination.

illustrated by a simple example. If ten allelomorphic pairs of genes are involved, one member of each pair being favorable to development, the other not, then one gamete, or one sporophyte originating from a gamete, in 1024 would receive all favorable genes, while with sexual reproduction only one sporophyte in 1,048,576 would be expected to receive all favorable genes. Planted a foot apart in three-foot rows it would require only about one-fourteenth acre to grow the former number of plants and more than 72 acres to grow the latter. Even if unlimited land were available it would be virtually impossible to identify the desired plant when sexual reproduction is involved.

Though the differences between gametic and zygotic selection would not, in actual practice, be as simple as this, there is no question that the possibility of gametic selection through induced parthenogenesis is one which

has not been sufficiently considered and one which would justify continued effort in attempting to induce parthenogenesis in maize, either by hybridization or by artificial, chemical, or physical stimuli, such as X-rays. It offers the only reasonable hope of obtaining homozygous strains of maize equal or superior in productiveness to the best first generation hybrids, a goal which is scarcely worth attempting by present methods of selection, as Jones[8] has so clearly pointed out.

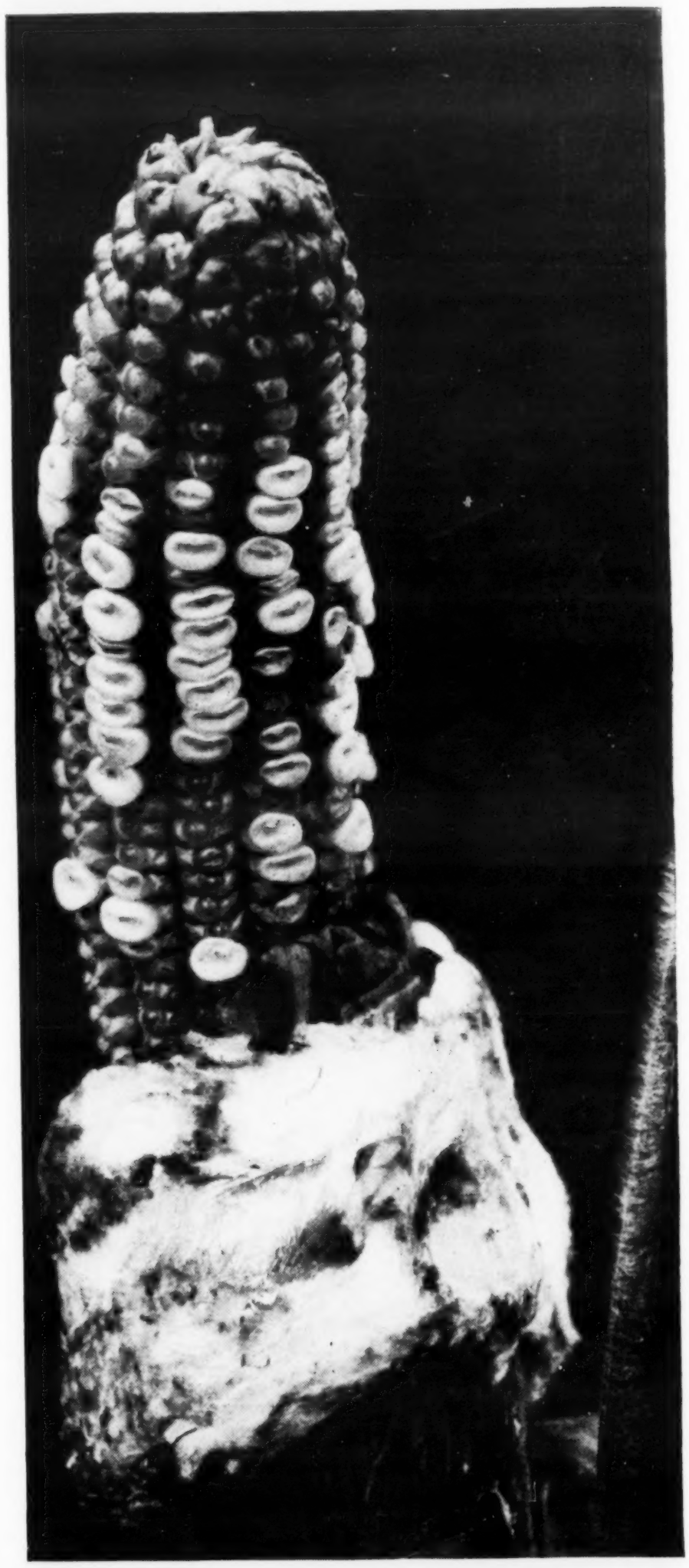
With these considerations in mind we have made extensive efforts to induce parthenogenesis in maize by hybridization with Tripsacum and, though our results to date are negative, we have succeeded in obtaining true hybrids of Zea and Tripsacum. It is to report the occurrence of these hybrids that this account is primarily written.

Crossing Maize and Tripsacum

Our experiments with Tripsacum have involved mainly only two forms. One of these, hereafter known as Texas Tripsacum, was collected near Angleton, Texas, where it is common in the prairies of the Gulf Coast Region. This form has stiff, erect, narrow leaves and resembles *T. floridanum* in some respects, though it has been identified as *T. dactyloides* by Dr. A. S. Hitchcock. Its somatic chromosome number is 36. Practically all of our pollinations have been made with this form.

The second form, hereafter known as Connecticut Tripsacum, was collected in a marsh near New Haven, Connecticut. It is typically *T. dactyloides*. The somatic chromosome number is 72 and there is some indication that it is a tetraploid, the chromosomes during meiosis showing some tendency to assort in tetrasomes instead of disomes. The two strains are illustrated in Figure 1.

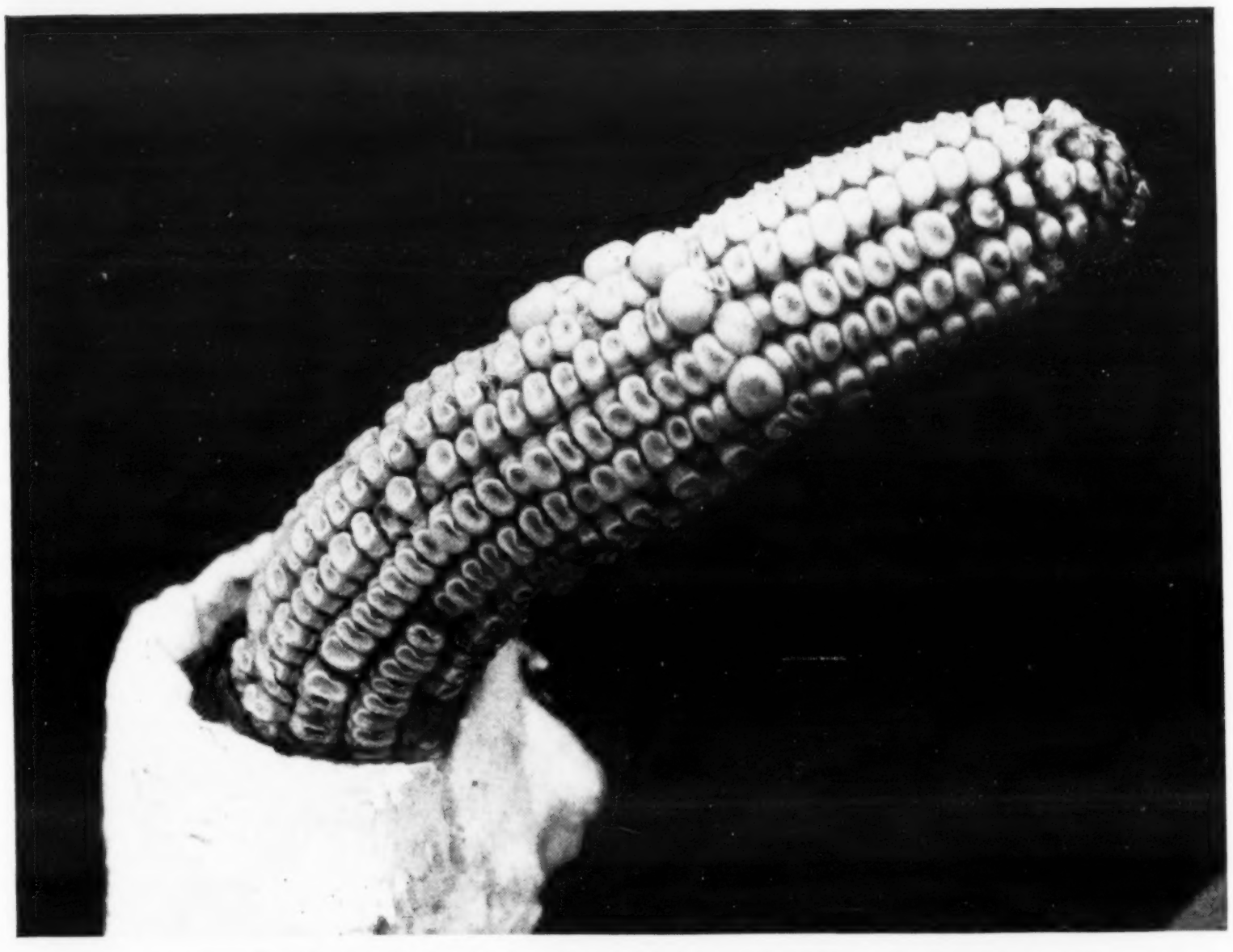
In 1929 pollen from the Texas Tripsacum was applied to the silks of maize. Within 24 hours the silks had wilted, as they normally do when corn pollen is applied, and microscopic examination showed that the pollen grains of Tripsacum had germinated and many of the pollen tubes had entered the styles.



CROSSED SEEDS OF MAIZE × TRIPSACUM

Figure 3

The small watery "seeds" are not seeds, but merely swelled nucelli resulting from the stimulus of pollination. The true seeds on this ear, which are larger and more opaque, are hybrids and contain both embryo and endosperm.



A SUCCESSFUL POLLINATION WITH TRIPSACUM

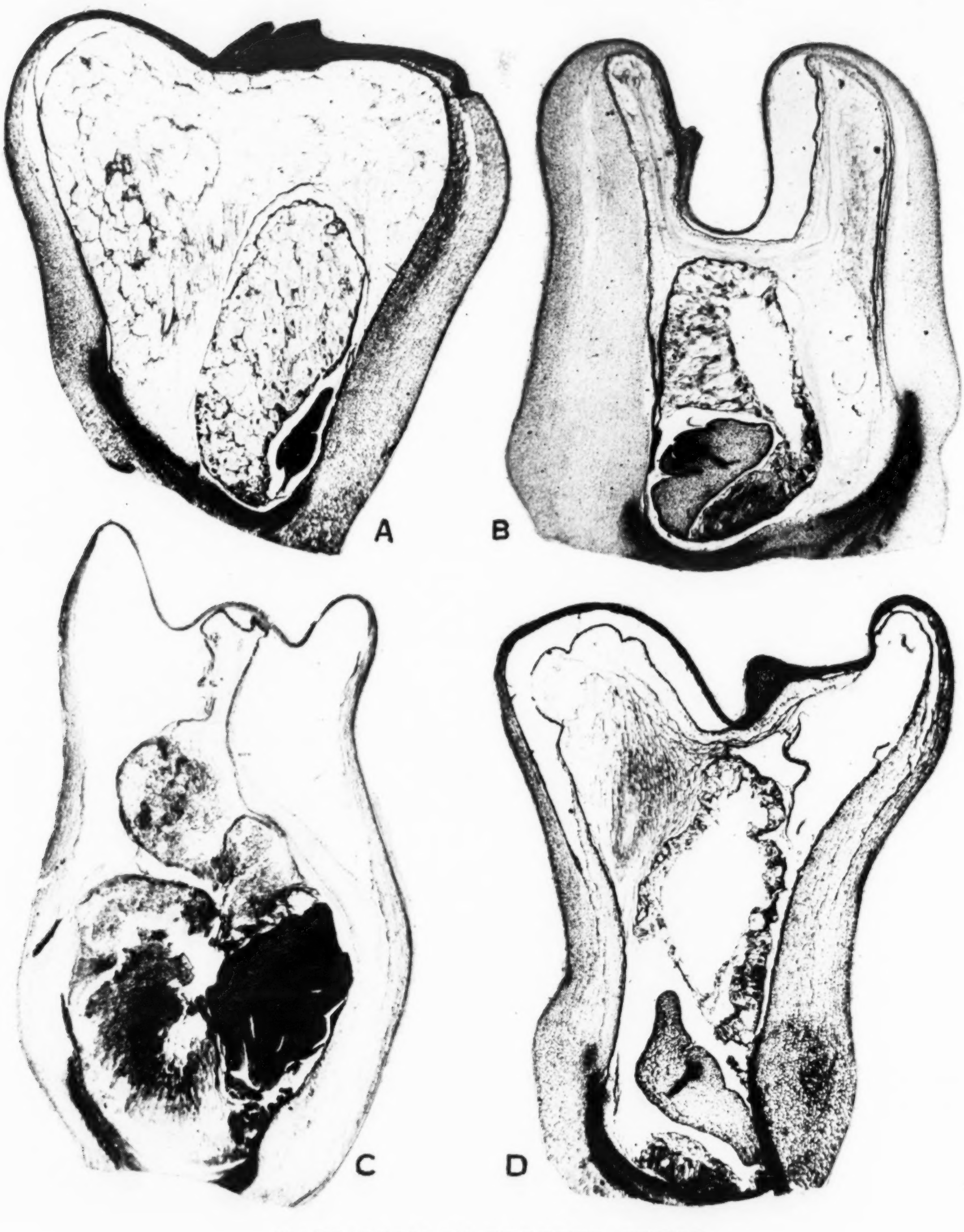
Figure 4

Some ears set seed almost 100 per cent. The hybrid seeds, however, are very small compared to maize seeds of the same age. A few maize seed near the middle resulted from pollinating with maize 24 hours after pollinating with Tripsacum. Note that some of the hybrid seeds adjacent to the maize seeds are larger than their sibs.

No seed development occurred, however, and fertilization presumably had not been accomplished. Since the silks of the Texas Tripsacum are usually less than an inch in length, while those of maize are generally several inches to more than 12 inches in length, the distance to be traversed by the Tripsacum pollen tubes in reaching the micropyle in maize is many times as great as that normally required of the tubes in fertilizing their own species. The obvious solution of this difficulty was to shorten the styles of maize. This was first tried in a group of 10 plants. In half of these plants the pollinations were made on silks of normal length. In the other five plants an incision was made through the husks on one side of the ear and the silks from a narrow region of the ear were cut back to less than an inch in length before the Tripsacum pollen was applied. The results were very decisive. In the five ears with normal silks no development of any kind occurred. Of the five ears with shortened silks every one produced some seeds and these seeds were confined to the narrow region of the ear in which the silks had been shortened.

The season, by this time, was considerably advanced and few maize plants were available. Twenty-seven additional ears were pollinated, however, and from these a few very small, shriveled seeds were finally matured. Several typical maize seeds were also produced which later proved to be heterozygous and were undoubtedly due to contamination.

In 1930 these experiments were repeated on a more extensive scale with much greater precautions against contamination. Seven ordinary commercial varieties of maize and several genetic



VARIATION IN CROSSED SEEDS

Figure 5

Most of the hybrid seeds are very abnormal in development. These photomicrographs show some of the peculiarities which occur. (*A*) Embryo and endosperm normal in structure though reduced in size. (*B*) Embryo severely distorted. (*C*) Embryo distorted and endosperm lobed. (*D*) Embryo at right angles to axis of seed.

stocks were grown in an isolated plat surrounded on two sides by woods and on the other two by buildings with no other maize nearer than 300 yards, and this to the north, directly opposite from the direction of prevailing summer

winds. Tassels were removed each morning as soon as they had emerged and before pollen was shed. In addition, the usual precautions during pollination were observed. All ear shoots were bagged before the silks had emerged and ears were immediately covered after pollination.

In pollinating these plants with Tripsacum the entire shuck was removed by a circumcision at the base of the ear. The silks were then cut off with an ordinary pair of shears. After pollination, the ear was covered with an artificial shuck to prevent possible contamination by wind blown pollen and also to forestall insect damage and excessive drying. Ordinary crepe paper wrapped over a strip of cotton, wound around the base of the ear, furnished a very satisfactory shuck and one that expanded readily to accommodate the growth of the ear. Figure 2 illustrates the steps in this procedure.

Development of the Crossed Seeds

The results of pollinating 382 ears with Tripsacum are shown in Table I. The number of silks pollinated is an estimation arrived at by multiplying the number of rows on each ear by the number of silks exposed to pollination on one row. The number of seed set was determined by actual count during the third week after pollination, except in two lots, indicated by asterisks, where seeds on only part of the ears were counted, and the total numbers are estimates based on this sample.

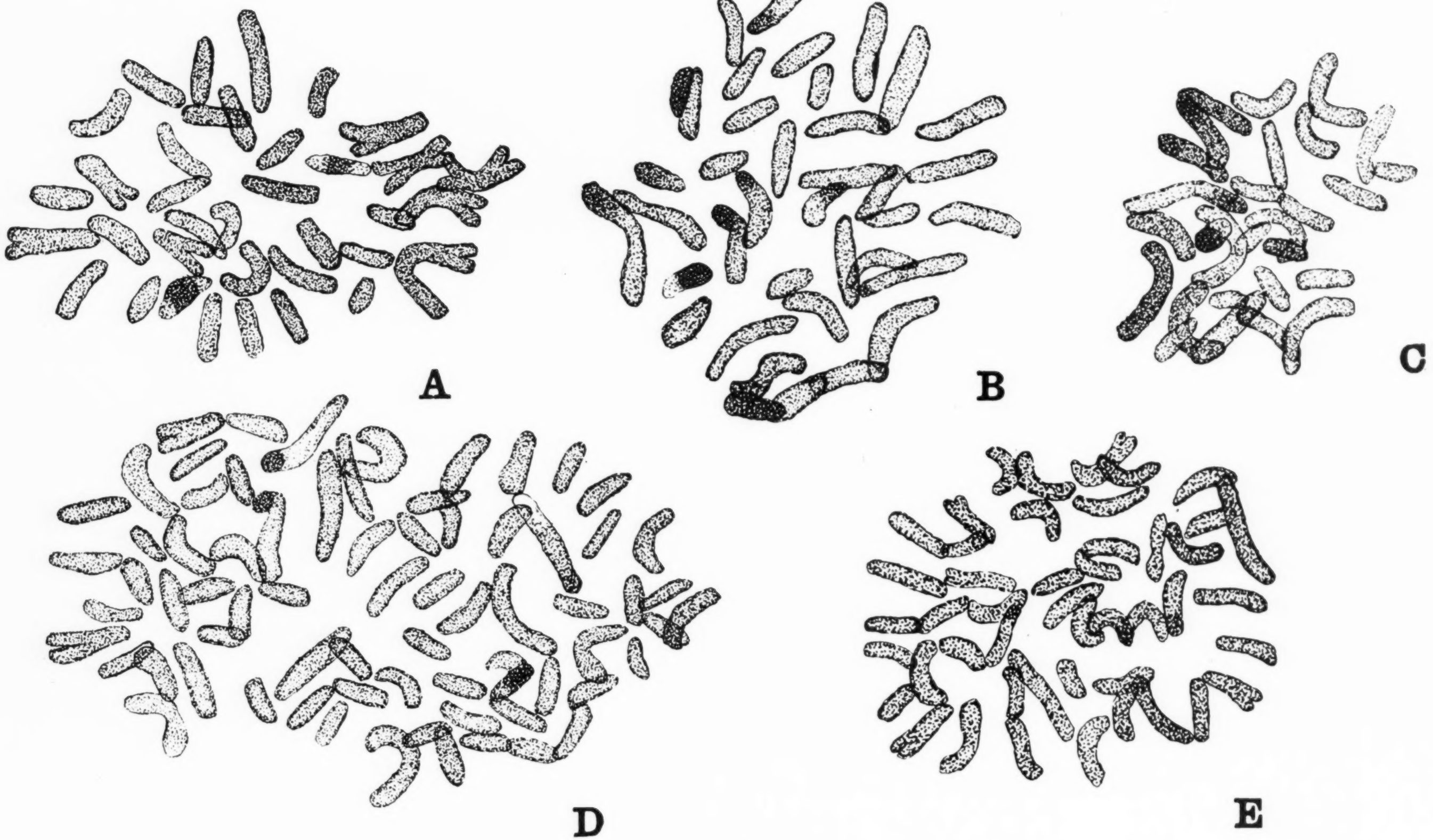
In some varieties almost every pollinated ear developed at least a few seeds, some ears setting 90 per cent or more.

There is a great deal of variation in the development which occurs when maize is pollinated with Tripsacum. In addition to the true seeds which contain both endosperm and embryo, and have a white, opague appearance, there are many parthenocarpic ovaries which possess neither embryo nor endosperm and are watery and translucent in appearance. Both types are illustrated in Figure 3. The development of the parthenocarpic ovaries is the result of a marked swelling of the nucellus which sometimes grows rapidly enough to burst through the pericarp. There is no evidence that fertilization has occurred and it is probable that the pollen tubes in the styles are capable of stimulating nucellar swelling without entering the micropyle.

In addition to the swollen nucelli, thousands of true seeds were formed and only these are included in the counts set forth in Table 1.

Even among the true seeds there is marked variation. Practically all of them, however, begin to shrivel about three weeks after pollination and at maturity only the empty pericarp remains. Anatomical studies of the developing seeds show that many kinds of abnormalities may occur. The embryo and endosperm may be normal in structure, though greatly reduced in size (Figure 5A). More frequently, however, the embryo is severely distorted (Figure 5B) and this distortion may occur in a variety of ways. Apparently there is no definite growth pattern and cell division occurs more or less at random. This is also evident in the endosperm which is frequently lobed (Figure 5C). In some cases the embryo seems to have lost its polarity and its axis may lie at various angles to the axis of the seed. Figure 5D shows a section through an ovary in which the longitudinal axis of the embryo lies at right angles to the axis of the ovary. When the embryo and endosperm reach maturity they usually occupy only a small portion of the space within the ovary wall.

These figures illustrate but a few of the peculiarities which occur in the hybrid seeds, and merely serve to emphasize the fact that development, on the whole, is decidedly abnormal. The combination of germplasm from these two distantly related genera is apparently not conducive to normal development, at least in the early stages.



SOMATIC CHROMOSOMES OF TRIPSACUM AND ITS HYBRIDS WITH MAIZE

Figure 6

(*A*) Texas Tripsacum: 36. (*B*) Endosperm of maize x Texas Tripsacum: 38. (*C*) Embryo of maize x Texas Tripsacum: 28. (*D*) Connecticut Tripsacum: 72. (*E*) Root tip of maize x Connecticut Tripsacum: 46.

All of the crossed seeds are very much smaller than normal seeds of corn of the same age. Figure 4 illustrates an ear pollinated with Tripsacum and pollinated 24 hours later with maize.

Effect of Maize Seeds on Adjacent Hybrids

Of possible interest in connection with the physiological aspects of nutrition of hybrid seeds is the fact that hybrids adjacent to pure maize seeds are frequently larger and survive longer than hybrid seeds growing alone. This is illustrated by several seeds in Figure 4 and is further shown by the fact that mature hybrid seeds on ears which were later pollinated with maize were 39.8 per cent heavier than hybrid seeds on ears, of the same varieties, which had received only Tripsacum pollen. (Table II.) This may indicate that the growth of normal seeds stimulates a flow of nutritive materials into the region which they occupy and the hybrid seeds obtain some benefit of this increased nutrition, though they are incapable of inducing it. Perhaps the failure, reported by Laibach,[9] of hybrid seeds of flax to develop in the ovaries of the maternal parent, though they could be matured in artificial media, is due to the fact that hybrid seeds are often incapable of stimulating a flow of nutrient materials and not because the maternal tissues are toxic to the developing hybrid, as Laibach seems to imply.

In any event the increased size of hybrid seeds adjacent to normal seeds is an observed fact; one which has proved useful in facilitating the hybridization of Zea and Tripsacum, and may possibly be utilized in the hybridization of other genera or species.

Chromosome Numbers in Embryo and Endosperm

Since one of our chief considerations in making these pollinations was that of inducing parthenogenesis, we have made chromosome counts in the developing seeds to determine whether any of them are haploid or diploid maize or Tripsacum. These counts were made both in the embryo and endosperm since parthenogenesis might conceivably occur in one structure and not in the other. Naturally only a relatively few seeds could be studied cytologically, but since the chromosomal condition was found to be the same in small and large seeds, there is no indication that part of the seeds are parthenogenetic and others true hybrids. The conditions found in all seeds studied are illustrated in Figure 6. Texas Tripsacum, as already indicated, has a haploid chromosome number of 18. The endosperm of the hybrid seeds usually has 38 chromosomes, which is the number expected if triple fusion takes place normally and two haploid sets of 10 chromosomes from corn combine with one set of 18 from Tripsacum. The embryos of these seeds usually have 28 chromosomes, the sum of the haploid numbers of the two parents.

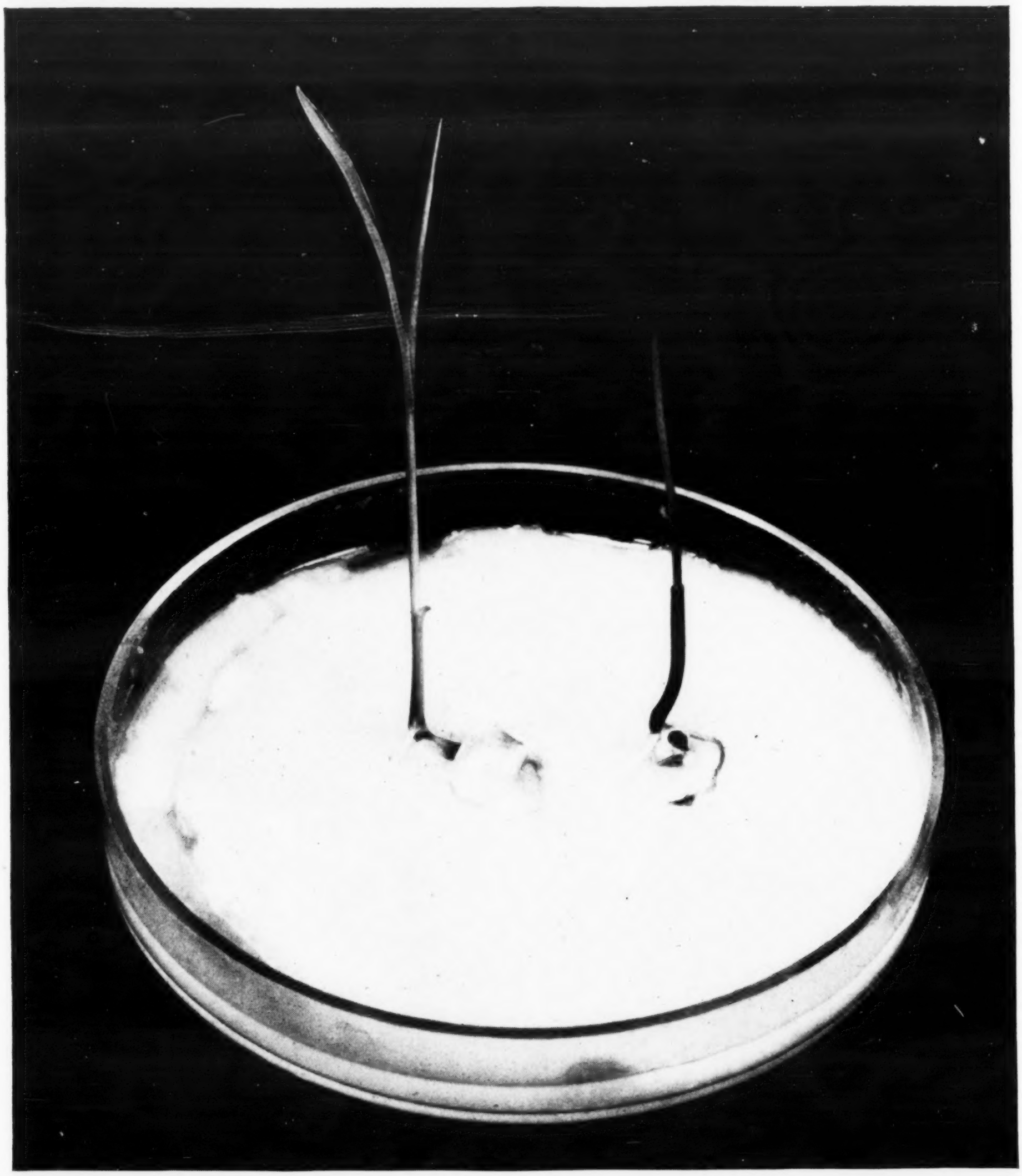
Similar crosses with the Connecticut Tripsacum, (n=36), show 46 chromosomes in the cells of the root tips, the number expected if 36 chromosomes from Tripsacum combine with 10 from corn.

No indication whatever of induced parthenogenesis, either of the female or male gametes, has been observed.

Few Seeds Mature

Most of the hybrid seeds begin to shrivel about three weeks after pollination and at maturity practically all of them consist of little more than the empty pericarp, the endosperm and embryo having been partially or completely resorbed. A few, however, reach maturity, though these, too, are very small, the largest of them being about the size of a grain of pop corn. Table III shows the weight of some of these seeds in comparison with the weight of maize seeds of the varieties on which these hybrid seeds were borne.

Endosperm of maize x Connecticut Tripsacum: 46. (*B*) Endosperm of maize x Texas Tripsacum: 36. (*C*) Root tip of maize x Connecticut Tripsacum: 72. (*D*) Root tip of maize x Texas Tripsacum: 36. (*A*)



GROWING ABORTIVE SEEDS IN AGAR

Figure 7

The crossed seeds of maize × Tripsacum are shriveled and abortive and germinate only under optimum conditions. Sterile agar has proved the best medium for germination.

It is noted that the average weight of the crossed seeds is 38 mg. as compared to an average weight of 268 mg. for normal maize seeds of the same varieties. The crossed seeds weigh only 14.2 per cent as much, on the average, as normal maize seeds of the same varieties and are about the same size at maturity as normal maize seeds harvested in the third or fourth week after pollination.

How rarely even these small seeds mature is shown by Table I. Out of approximately 185,000 silks exposed to pollination, approximately 35,000 set seed and of these only 84 matured;

an average of 4.54 seeds matured per 10,000 silks pollinated.

Apparently there are differences in maize varieties in ability to cross with Tripsacum. From the Horton variety we have never obtained a mature crossed seed, either in 1930 or the previous year. A first generation hybrid of Yellow Creole × Surcropper is intermediate between its two parents, indicating that differences in "crossability" are hereditary, a condition similar to that observed in wheat-rye crosses by Backhouse,[1] Leighty and Sando,[10] and others.

In addition to the 84 mature crossed seeds obtained by pollinating 382 ears with Texas Tripsacum, we obtained 15 seeds from crossing only a few ears with Connecticut Tripsacum. Apparently the Connecticut form crosses more readily with maize than the Texas form, though the divergence in chromosome number of the parents is much greater in the former cross than in the latter.

Germinating Shriveled Seeds

In both crosses the mature seeds are so small and shriveled that, planted in soil, they would probably never emerge. Even between moist blotters in a germinator the percentage of germination is low. By experimenting with partially developed, shriveled seeds of corn which showed no germination whatever under standard germinator conditions, we were able to develop a technique modified from that of Chen,[2] Pearl and Allen,[12] and others, which in some cases resulted in 100 per cent germination of seeds that showed no germination between moist blotters. This method has been used with such success in germinating hybrid seed of maize × Tripsacum, maize × perennial teosinte, and other poorly developed seed which would ordinarily be discarded, that it may not be amiss to include a brief description here.

The seeds are soaked about six hours in tap water at room temperature to induce softening or germination of seed borne spores, rendering them more susceptible to the action of fungicides. The pericarp is then removed completely. The seeds are soaked about 8 minutes in a one per cent solution of Semesan after which they are rinsed in boiled, distilled water and scattered in sterile, two per cent, agar in Petri dishes. The Petri dishes are kept in a glass-walled germinating chamber at a temperature of approximately 33° C. Some sprouting usually occurs within 18 hours. As the seedlings are exposed to light at all times, chlorophyll development begins immediately upon germination and this, no doubt, enables the young seedling to overcome partially the handicaps brought about by its deficiency in endosperm material and by its weak root system. Within six days the seedlings usually have two well developed leaves and can be potted off. After potting they are left in the saturated atmosphere of the germinator for several days. (See Figure 7.)

Of the 84 crossed seeds of maize × Texas Tripsacum, 45, or more than 50 per cent, germinated and 29 have survived transplanting in the field. Of the 15 seeds of the cross with Connecticut Tripsacum, only four germinated and only one still survives. Chromosome counts have been made from the root tips of a number of the hybrid seedlings. The chromosome number in the cross maize × Connecticut Tripsacum is 46; in the cross maize × Texas Tripsacum, 28.

After developing an adequate temporary root system, practically all seedlings have grown normally except that several of them became chlorotic in the third or fourth week of development. Some of the leaves were completely albinotic but new leaves emerging later were normal green.

Hybrids Resemble the Pollen Parent

The hybrid seedlings can be distinguished from those of either parent though they resemble Tripsacum, the pollen parent, more closely than maize, the seed parent. In rate of growth, width of leaves, color of leaves, tiller-

F_1 PLANT OF MAIZE × TRIPSACUM

Figure 8

The hybrid resembles Tripsacum more closely than maize. It tillers profusely, has a perennial habit of growth, and an inflorescence very similar to that of Tripsacum.

ing habits, and other characteristics, the resemblance to Tripsacum is very marked. In the cross maize × Connecticut Tripsacum, in which the Tripsacum parent contributed 36 chromosomes and maize but ten, the resemblance to Tripsacum is more pronounced than in the maize × Texas Tripsacum hybrids which received only 18 Tripsacum chromosomes. This is probably to be expected since the proportion of Tripsacum chromosomes to maize chromosomes is twice as great in the first case as in the second.

INFLORESCENCE OF MAIZE × TRIPSACUM

Figure 9

Most taxonomic botanists would probably call this an inflorescence of Tripsacum, so close is the resemblance to its pollen parent. It does, however, have some characteristics of maize. Note that the silks are fused most of their length but divided at the ends.

The hybrid of maize × Connecticut Tripsacum was planted six months earlier than the others and is the only one which has flowered when this is written. The inflorescence, though showing some characteristics of its maize parent, resembles Tripsacum very closely and would probably be classified as a species of Tripsacum by a taxonomic botanist. Like Tripsacum, the staminate and pistillate spikelets are borne on the same rachis, the former above, the latter below. The pistillate spikelets are enclosed in an indurated shell consisting of the rachis and the outer glume. The terminal inflorescence has five erect branches, two more than ordinarily occurs in Tripsacum. The silks are longer than those of Tripsacum, averaging 38 mm. as compared to 22 mm. for those of the Tripsacum parent. Most of them are divided only at the ends while Tripsacum silks are divided to the base and have the appearance of occuring in pairs. The silk color is pink, being intermediate between the red silks of the Tripsacum parent and the green silks of the maize parent. In time of flowering of the pistillate and staminate spikelets the hybrid resembles Tripsacum, which is always protogynous while maize is usually protandrous. As a matter of fact, the anthers of the hybrid do not dehisce at all because they contain only aborted pollen, but they are still green when the silks emerge and do not turn yellow until several days later.

Preliminary Studies of Meiosis

The hybrid seems to be completely sterile. No pollen has been shed and so far no seeds have set, either when Tripsacum or maize pollen was applied. Preliminary cytological studies of meiosis in the pollen mother cells suggest the probable causes of this sterility, though the details must be verified by further studies now in progress.

At the first division there are usually 18 bivalents and ten lagging univalents. The Tripsacum parent of this hybrid, as has already been suggested, is probably a tetraploid. Thus the hybrid receives a complete assortment of Tripsacum chromosomes and these are ca-

pable of pairing among themselves. Presumably the 18 bivalents represent the 36 Tripsacum chromosomes, and the ten lagging univalents constitute the ten maize chromosomes. This situation is similar to that reported by Collins and Mann[5] in certain Crepis hybrids.

As the bivalents disjoin and proceed to the poles, the lagging univalents remain on the plate and undergo an equational division.

In the second division the split univalents lag again and many, if not all, of them fail to reach the daughter nuclei. These form many small nuclei and at least some of them give rise to supernumerary microspores. Others remain in the same microspore with the large nucleus and may be one of the chief causes of aborted pollen.

Whether or not any of the maize chromosomes pair with those of Tripsacum or pair among themselves remains to be determined by further studies.

Other Crosses With Tripsacum

The reciprocal cross, Tripsacum × maize, has also been attempted but, so far, without success. Though the pollen of maize germinates readily on the styles of Tripsacum and many pollen tubes enter the stylar tissue, no mature seeds have ever been obtained, perhaps mainly because it is difficult to make the enormous number of pollinations necessary to obtain viable seeds.

The cross of Tripsacum and perennial teosinte has never been successful, no matter which of the two genera was used as the maternal parent. Annual teosinte, however, can be crossed with both forms of Tripsacum if teosinte is used as the seed parent and its silks shortened. Seeds are set less frequently than in the cross, maize × Tripsacum, and all of them, so far obtained, have shriveled before maturity. Perhaps mature seeds could be obtained if enough crosses were made, but our observations indicate that teosinte crosses with Tripsacum less readily than does maize.

Chromosome counts in the cells of young seeds of teosinte × Tripsacum show that both embryo and endosperm are hybrids and neither are due to induced parthenogenesis.

In the light of our experiments it is difficult to account for the peculiar results of Collins and Kempton.[4] It is surprising that they obtained seeds at all since we have been able to do so only by the use of a tedious technique and by dealing with enormous numbers. It is even more surprising that all of their crosses resulted in matroclinous or patroclinous plants, presumably resulting from parthenogenesis, while all of the seeds that we have so far obtained have proved to be true hybrids.

Literature Cited

1. Backhouse, W. O. Note on the inheritance of "crossability." *Jour. Genetics*, 6, pp. 91-94. 1916.

2. Chen, C. C. Internal fungous parasites of agricultural seeds. *Md. Agric. Expt. Sta. Bull. No.* 240, pp. 81-110 1920.

3. Collins, G. N. Teosinte in Mexico. *Jour. Hered.*, 12, pp. 339-350. 1921.

3a. Collins, G. N. The phylogeny of maize. *Bull. Torrey Bot. Club* 57: 199-210. 1931.

4. Collins, G. N., and Kempton, J. H. Patrogenesis. *Jour. Hered.*, 7, pp. 106-118. 1916.

5. Collins, J. L. and Mann, M. C. Interspecific hybrids in Crepis II. A preliminary report on the results of hybridizing *Crepis setosa* Hall with *C. Capillaris* (L) Wallr. and *C. biennis* L. *Genetics*, 8, pp. 212-232. 1923.

6. East, E. M. The production of homozygotes through induced parthenogenesis. *Science*, 72, pp. 148-149. 1930.

7. Emerson, R. A. Genetic notes on hybrids of perennial teosinte and maize. *Amer. Nat.*, 63, pp. 289-300. 1929.

8. Jones, D. F. Selection in self-fertilized lines as the basis for corn improvement. *Jour. Am. Soc. Agron.*, 12, pp. 77-100. 1920.

9. Laibach, F. Ectogenesis in plants. *Jour. Hered.*, 20, pp. 201-208. 1929.

10. Leighty, C. E., and Sando, W. J. Natural and artificial hybrids of a Chinese wheat and rye. *Jour. Hered.*, 19, pp. 23-27. 1928.

11. Longley, A. E. Chromosomes in maize and maize relatives. *Jour. Agric. Res.*, 28, pp. 673-682. 1924.

12. Pearl, Raymond, and Allen, Agnes

L. Notes on the growing of seedlings for physiological experimentation. *Proc. Soc. Expt. Biol. and Med.*, 24, pp. 439-444. 1927.

13. WEATHERWAX, PAUL. Comparative morphology of the oriental Maydeae. *Ind. Univ. Studies, No.* 73, 13, pp. 3-18. 1926.

TABLE I.—Results of pollinating different varieties of maize by Texas Tripsacum.

Variety	—*No. pollinated*— *Ears*	*Silks*	*No. set*	*Per cent set*	*No. matured*	*No. matured per* 10,000 *pollinated*
Horton	21	11,848	469	4.0	0	0
Su su	24	14,762	995	6.7	4	2.71
Wx wx	16	6,736	916	13.6	2	2.97
Yellow Creole	46	24,886*	5,622*	22.5	10	4.02
Thomas	43	20,606	2,017	9.8	9	4.37
Creole × Surcropper	47	22,556	6,715	29.8	10	4.43
Mexican June	41	18,580	5,343	28.8	9	4.84
Misc. stocks	82	39,184*	7,827*	26.8	23	5.87
Surcropper	62	25,766	4,650	18.0	17	6.60
Total	382	184,924	34,554	18.7	84	4.54

*Estimates based on sample.

TABLE II.—Weights of hybrid seeds on ears also bearing maize seeds, compared to hybrid seeds occurring alone.

Variety	*Weight in mg. With maize*	*Alone*	*Gain or loss in per cent*
Surcropper	71.9	43.4	65.7
Hastings' Prolific	50.0	19.8	152.5
Thomas	47.3	26.1	81.2
Mexican June	46.6	31.6	47.5
Creole × Surcropper	36.5	42.0	—13.1
Average	50.9	36.4	39.8

TABLE III.—Normal weights of maize seeds compared to weights of crossed seeds on ears of same variety.

Variety	*Weight in mg. Maize*	*Hybrids*	*Per-cent normal*
Queen's Golden Pop	130	35	26.9
Waxy	204	40	19.6
Thomas	262	49	18.7
Yellow Creole	262	30	11.5
Hastings' Prolific	264	34	12.9
Mexican June	341	20	5.9
Surcropper	411	57	13.9
Average	268	38	14.2

Mental Tests for Infants

MENTAL MEASUREMENT OF PRE-SCHOOL CHILDREN, *by* RACHEL STUTSMAN. Pp. X+368. World Book Company, Yonkers-on-Hudson, New York, 1931.

THE testing of intelligence, when carried out by an expert and when the limitations of the tests are properly evaluated, is of indisputable importance in sizing up both normal and abnormal children, as well as in estimating the nature of the deviations in mental disorders of the adult.

The mental testing of children in the preschool age is of particular value in indicating the direction in which future training should proceed, and moreover it has been recognized that the educational as well as the medical treatment of mentally defective and backward children yield greater results if instituted during the earliest years of childhood. It is, therefore, important to detect any inferiority as early as possible. As emphasized by Terman, who wrote a brief introduction to the present volume, the devising of tests for the preschool years offers many difficulties, among which are a more

limited choice of material than for older children, a less easily established and maintained rapport with the subject to be tested, more flexible testing procedures, and more difficulty in evaluating the performances.

There are several efficient intelligence scales adapted to children of five or six years or older, but only a few that are reasonably standardized for those of three or younger. Gesell whose "developmental schedules" are of value in the qualitative analysis of performances, and Goodenough and Kuhlmann have made definite contributions to the subject, but Stutsman has offered a scale in the present volume, which should insure a wide field of usefulness, as it possesses several outstanding merits, among which are careful selection of the tests from a psychological viewpoint, a regard for the practical aspects of the testing situation, and a rigid scientific definition of these tests from the standpoint of objectivity, scoring and comparability of the results obtained.

The book consists of twenty chapters arranged into four parts. Part One sets forth the various problems in this field and makes a comprehensive review of the history of the mental testing movement in connection with preschool children. Part Two deals with what is known as the Merrill-Palmer Research and includes discussions of various tests and experiments, methods of standardizing the scale, the statistical evaluation of results and the influence of environment, sex, etc. on the test score.

Part Three contains the directions for using the Merrill-Palmer Scale. These tests are given in a wealth of details and their values are fully explained in the text. Part Four presents numerous illustrative case studies which reveal problems in heredity, in physical condition, in environment, in foreign language handicap and in various other handicaps. In commenting on heredity the author states:

> Many studies have shown that the heredity of the child has a definite relation to his mental level. This principle has been accepted so heartily by some persons that they condemn without a hearing children of poor heredity. Children born of mothers in schools for the feebleminded, for instance, are sometimes kept there regardless of their own mental level, the state recognizing no possibility of a normal child under such conditions. The writer has tested, in schools for the feebleminded, several children with such a history who proved to have average or superior mentality! Yet there was no other place for them to go, for only rarely is anyone willing to take such children intc his home.
>
> However, the heredity of the child must undoubtedly be considered seriously in the diagnosis of mental level and in the prognosis for his future. Of two children, both of whom have a low test score and live in an inadequate environment, the child who has a hereditary history of mental inferiority has a much less favorable prognosis than has the child whose ancestors were of average mental ability.

N. D. C. Lewis.

Proud of Our Weeds

If a gardener cultivated his garden by carefully coddling and protecting the weeds, they would soon choke all the flowers and fruit within the garden walls. Our civilization has tended increasingly to shelter the weeds as though we were proud of the enormous growth in our weed crop, and in our army of weed gardeners. Gaily we open new hospitals and increase their size; inebriates' homes, reformatory schools and asylums for the insane and the mentally afflicted spring up on every side. With boastful prodigality we bribe recruits to join the ranks of recipients of poor relief and unemployment benefit, as at the same time we mobilize and train new armies of doctors, dentists, nurses and wardens, but little is done to remove the underlying causes of unemployment, of idiocy, of ill-health and morbidity, of pauperism and crime.—Pitt-Rivers, George. *Weeds in the Garden of Marriage*, Page 66.

INHERITANCE OF HERNIA

In a Family of Holstein-Friesian Cattle*

T. R. Warren and F. W. Atkeson
Idaho Agricultural Experiment Station

SEVERAL calves with umbilical hernia were noticed in two herds of purebred Holstein - Friesian cattle in which the same herd sire had been used. Cursory investigation of the herd records showed other calves similarly affected. The unusual number of herniated calves indicated that this defect might be heritable. This prompted an investigation of the relationship of the herniated calves with the view of determining whether or not umbilical hernia is a hereditary defect and, if so, the manner in which it is transmitted. Should hernia prove to be an inherited character, knowledge of its elimination or control should be of economic importance to breeders of purebred dairy cattle.

Review of Literature

Numerous authors offer a variety of opinions as to the causes of hernia. Accident, digestive disturbance, excessive pressure, muscular weaknesses, and heredity have been suggested most often. von Bergman,[10] in speaking of human beings, says:

> In Berger's statistics, including 10,000 cases of hernia, there were 137 cases of epigastric hernia, 120 of which were in males, and the majority were associated with hernias elsewhere . . . . Witzel claims that the condition was more common in people with some gastric disturbance . . . . Other authors consider that they may be of traumatic origin, and Witzel claims that 50 per cent of the cases may arise in this way. A direct blow upon the stomach or lifting may be the primary cause, or an already existing hernia may be sufficiently enlarged by these factors to become noticeable.

Stengel and Fox[8] consider hernia in human beings to be the result of strain or muscular weakness.

Ferguson[3] reports the efforts of several men who attempted to establish the prevalence of hernia in man:

> Marcy estimated that from one-eighth to one-sixteenth of the human race is afflicted with hernia. Baxter, Surgeon General, United States Army, showed that of 334,321 men of various nationalities examined 16,901 were rejected because of hernia. Malgaigne estimated that in France 3.6 per cent of the total population was ruptured; while Berger claims that in Paris only 0.44 per cent were ruptured.
>
> Hernia occurs more often in the male than in the female, the percentage of frequency varying from three to five. Mr. Kingdon, of London, stated that there are 6.7 per cent of males ruptured to 1 per cent of females.

Coley[7] states: "About 25 per cent of persons with rupture give a family history of hernia."

Davenport[1] in writing of hernia in man states: "That such weakness or liability to hernia is inherited admits of little doubt. Just how, there is hardly sufficient data to determine with certainty."

Warwick[11] reports that Davenport has recently shown some evidence that hernia in human beings is inherited as a dominant.

Warwick[11] also reports that numerous writers have referred to hernias as being unquestionably of a hereditary nature. Among the most important of these writers he states are: Campbell, Fleming, Hobday, Joest, Leeny, Moller and Dollar, and White.

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The writers wish to acknowledge the valuable assistance of Prof. J. B. Fitch, head, department of dairy husbandry, Kansas State College, who collected portions of the data; and the helpful suggestions of C. A. Michels, assistant professor of agronomy, University of Idaho, and Dr. H. L. Ibsen, animal geneticist, Kansas State College.

Law[5] says that some forms of hernia in livestock, including umbilical hernia, are essentially surgical and need not be discussed further except in guarding against overlooking them as factors in producing intestinal and omental strangulation and colic.

Youatt,[12] writing in 1847, believed hernia in the pig to be inherited, but hesitated to make a positive statement because of the slight attention that had been paid to such diseases at that time.

Warwick[11] concludes from the data obtained that inguinal hernia in swine is definitely inherited as a recessive and suggests a two-factor hypothesis to account for hernias in males while females of similar constitution are normal because of their anatomical differences. He was able to increase the percentage of hernias from 14.28 per cent in the first generation to 42.0 and 43.18 per cent in the second and third generations respectively by controlled matings.

Dollar[2] reports the hereditary character of umbilical hernia as observed by Viborg and Eleonet in horses and by Benkert in dogs.

Murray[6] states: "In cattle the defective and abnormal condition of the umbilicus is frequently hereditary."

Data from the Iowa station,[11] covering five years of observation on hernia in animals, list one case of umbilical hernia in cattle, 122 in swine, 2 in dogs, 1 in horses, 1 in sheep, and 2 in cats, which probably indicates that in cattle this defect is either infrequent, pathologically unimportant, or that the hernias naturally disappear at an early age.

Hadley and Warwick[4] believe that more defects in animals are regarded as hereditary now than formerly because scientists are not content to accept what they see, but are interested in how it came about. They list the following inherited defects in cattle:

> Two different dominant ear defects of cattle, noted respectively by Yamane (1915) and Lush (1922); the "bull-dog" fetal calf, a condition caused by retarded functioning of the pituitary, and thought by Crew (1923) to have a definite genetic basis; polydactylism in cattle, recorded by Roberts (1921) . . . .; the defects mentioned by Wriedt in Norwegian Telmarken calves (1924a); the congenital cataracts in cattle described by Detlefsen and Yapp (1920) . . . . .; and the congenital epithelial defects of calves studied by Hadley (1926) . . . . .

Sources of Data

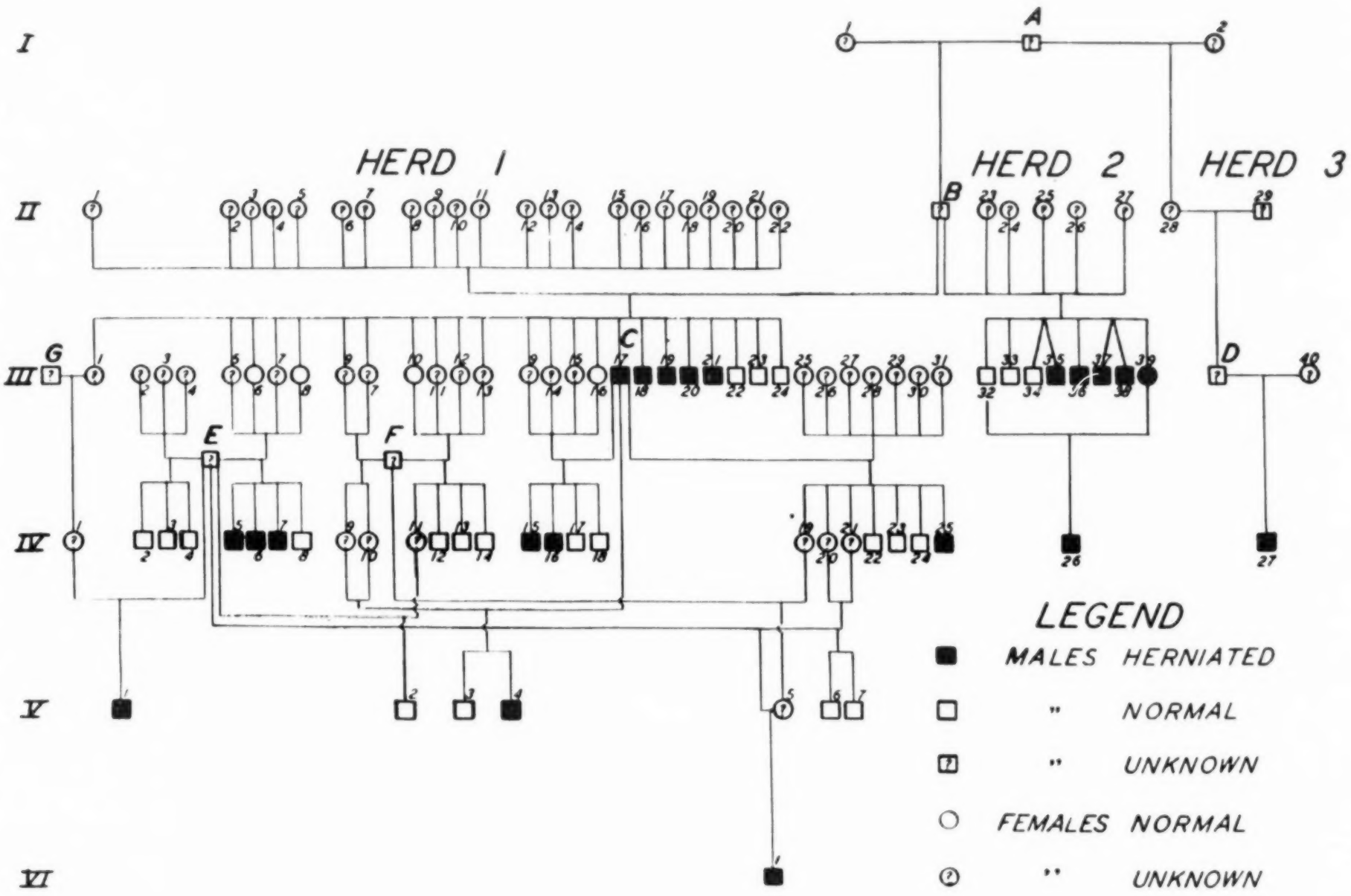
Data were collected from three herds which contained animals related to the sire in question. These herds are designated as 1, 2, and 3. The sires involved in the study are indicated by the capital letters *A*, *B*, *C*, *D*, *E*, *F*, and *G*, while all the other individuals represented are indexed by generations in Roman and Arabic numerals.

Twenty-one herniated calves of common breeding have been observed. Since June 1930 each calf born in herd 1 has been carefully examined at irregular intervals of from one to three weeks. Data gathered on each hernia included time of appearance, texture, size of hernial sac, size of hernial ring, and time of disappearance. Dr. E. M. Gildow, veterinarian, University of Idaho, assisted in the positive identification of the hernias. Pictures were taken of most of the herniated calves and of some of the unaffected animals. Nine calves with hernia have been observed in herd 1 since June 1930. Five additional herniated animals from this family were located through herd records and correspondence with nine breeders who had purchased bulls from this herd.

Data obtained from herds 2 and 3 were gathered by reliable parties and, considering the precautions observed, there is little question that the cases are similar to those in herd 1.

Description of Hernias Observed

The hernias appeared in calves between the ages of 8 and 20 days and with one exception were limited to males. This hernial condition in males persisted in varying degrees until the calves were between 10 weeks and 7 months of age, during which time the hernial sacs seemed to contract, permitting the hernial rings to close. Con-



HERNIA IN A FAMILY OF HOLSTEIN-FRIESIAN CATTLE

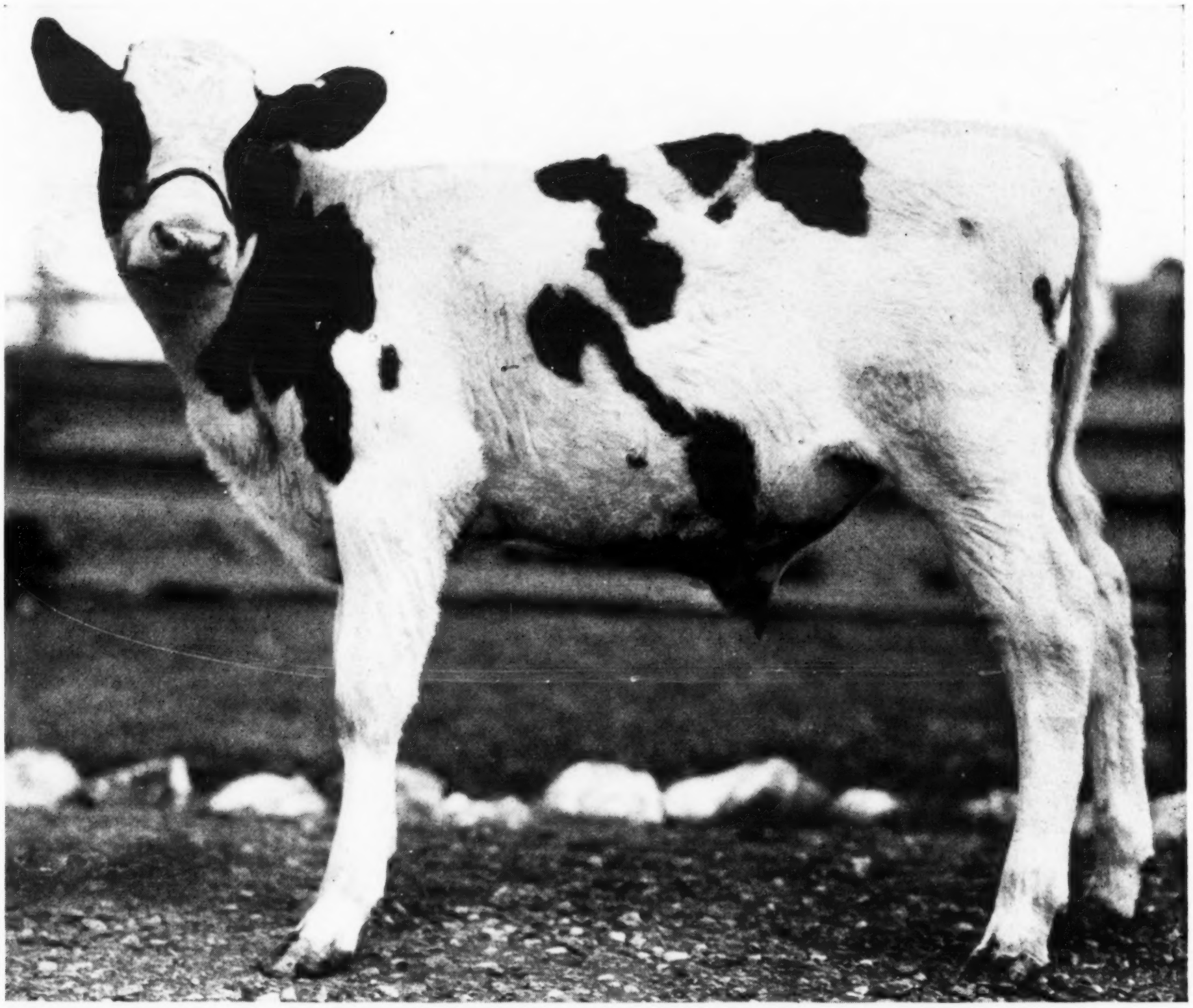
Figure 10

The occurrence of herniated animals in five generations from the original sire *A*, together with the relationships involved. The tendency to hernias appears to be a sex-limited dominant factor, as only one herniated female was found.

tents of the hernial sacs observed were usually soft and flexible and could be pushed into the abdominal cavity through the circular hernial ring with relatively little pressure. Hernial rings were found to vary from approximately 1½ to 5 centimeters and hernial sacs from 5 to 12 centimeters in diameter. The smaller hernias disappeared sooner than did the larger ones. In only one instance was a hernia reported to persist in an animal beyond seven months of age. In this case the animal was reported affected at six years of age, the hernial ring being approximately 5 centimeters in diameter.

Data on each of the 20 herniated males reported are presented in Table I. Figure 10 shows the occurrence of calves affected with hernia and indicates the relationships of the animals involved.[9]

Sixty-two calves in herds 1 and 2 are known to have been either normal or affected with hernia. Of this number 41 were males and 21 were females. Thirty-eight of the males and 19 of the females, or 57 of the 62, were related to herd sire *B* that had been used in both herds. Of the 21 females one was reported herniated, but from evidence available it is believed that this case of hernia was due to some cause other than heredity. Of the 38 related males 19 were herniated and 19 were normal. It appears, therefore, that heritable hernia may be limited to males. Consequently, no females have been included on Figure 10 except where they have male descendants that are used in the study. All of the 41 males in herds 1 and 2 are represented on the chart with the addition of one affected male



HERNIATED CALF VI-1

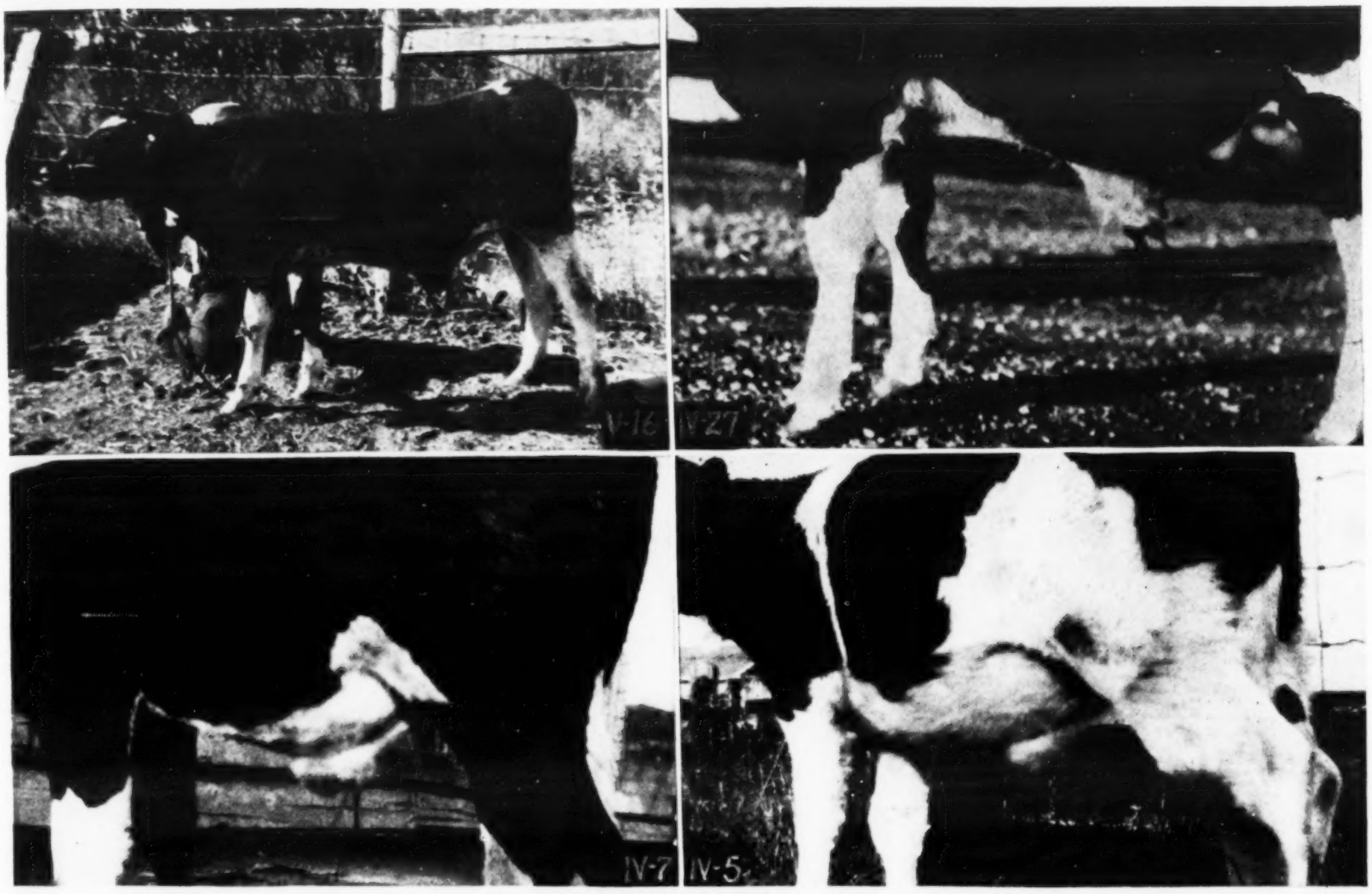
Figure 11

All the herniated individuals in this study trace back to a single sire. The dam of this individual was normal, but he had a herniated great-grandsire.

from herd 3. The male and female ancestors in the pedigrees of these 42 males are indicated back to the foundation cows and sire *A*.

Figure 10 shows that all the affected individuals are descended from sire *A* through one son and one daughter. In herd 3 the daughter II-28 of sire *A* is evidently responsible for the transmission of hernia through her son III-D to her grandson IV-27. Other male calves of similar breeding in this herd are known to have been affected, but careful observations were reported only on this calf. However, the fact that this herniated calf is a descendant of sire *A* is signficant. All calves affected with hernia in herds 1 and 2 are descendants of sire *A* through his son, sire *B*. When sire *B* was mated in herd 2 with five cows unrelated to him, seven sons were born, including two pairs of twins. Four of the seven were herniated and three were normal. Cow II-27 was twice mated to sire *B*, resulting in herniated twin bulls and a herniated heifer III-39. When the herniated heifer III-39 was mated to her normal half brother III-32 (both being by sire *B*), a herniated son, IV-26, was produced.

In herd 1 sire *B* left 16 sons, including 5 herniated, 3 normal, and 8 concerning which no data are available. The large proportion of herniated sons of sire *B* found in herds 1 and 2 leaves



FOUR HERNIATED CALVES

Figure 12

The numbers identify the individuals in the chart (Figure 10). Except in one instance all the hernias disappeared after the calves reached an age of from ten weeks to seven months.

no doubt that sire *B* transmitted this character.

Sire *C*, a son of sire *B*, when mated with four daughters of sire *B* produced four male calves, two of which, IV-15 and IV-16, were herniated and two, IV-17 and IV-18, were normal. In these cases the hernia might have been transmitted through either the son or the daughters of sire *B*. When sire *C* was mated with two granddaughters of sire *B* that were sired by out-cross sire *F*, one herniated calf, V-4, and one normal calf, V-3, were produced. Here again the defect might have come from sire *B* through either the male or the female lines. However, when seven cows unrelated to sire *A* were mated with sire *C*, one affected male, IV-25, three normal males, IV-22, IV-23, and IV-24, and three females were obtained, the affected male adding further proof that sire *C* was a carrier of the defect. Two of these females when bred to out-cross sire *F*, produced heifer V-5, who in turn when mated with out-cross sire *E* produced VI-1, a herniated great-grandson of *C*. Thus, sire *C* appears to transmit the defect, inasmuch as any characters of sire *B* expressed in IV-25 or VI-1 must come through sire *C*.

Sire *F* when mated with six daughters of sire *B* produced three normal males, IV-12, IV-13, and IV-14, and three females, one of which when bred to out-cross sire *E* produced a normal male, V-2. The other two when bred to sire *C* produced one normal male, V-3, and one affected male, V-4. This hernia might have been transmitted by either the male or the female descendants of sire *B*. Thus, the only herniated male descendants of sire *F* were V-4 and VI-1, previously mentioned, both of which were descended from sire *C*.

Sire *E* when mated with four daugh-

ters of sire *B* produced three affected males, IV-5, IV-6, and IV-7, and one normal male, IV-8. When mated with four granddaughters of sire *B*, one affected male, V-1, and three normal males, V-2, V-6, and V-7, were produced. He was also mated with one great-granddaughter which resulted in the herniated male VI-1. Three females, unrelated to sire *B*, when mated with sire *E* produced three normal males, IV-2, IV-3, and IV-4, indicating that he was probably not responsible for transmitting hernia.

A summary of the data reveals that of seven daughters of sire *B* bred to out-cross bulls, three bore herniated calves, while of four daughters of sire *B* bred to sire *C*, their half brother, two had herniated calves. Two granddaughters of sire *B* bred to an out-cross sire resulted in two males, one of which was herniated; but when sire *C*, a son of sire *B*, was mated with four granddaughters of sire *B*, one of four males was herniated.

Possible Mode of Inheritance

Definite conclusions as to mode of inheritance cannot be drawn from the limited data available. However, the defect seems to be inherited in a relatively simple Mendelian manner because of the apparent 1:1 ratic among males. If the one herniated heifer found among 21 females related to sire *B* was due to some cause other than heredity, then it may be concluded that the defect is confined to males and is probably associated with sex inheritance. Hernia inheritance does not appear to be sex-linked because sire *B*, who transmitted hernia to some of his sons, in turn had one son and five daughters that evidently transmitted the defect to their sons. It does, however, appear sex-limited. According to this hypothesis one of a pair of autosomes carries a sex-limited dominant factor for hernia. This permits one-half of the daughters of a heterozygous herniated male to carry the hernia factor, but it is not manifested, and also permits one-half of the male calves to carry and manifest the hernia factor.

Representing the dominant factor (hernia) by *H* and its recessive allelomorph (normal) by *h*, the herniated male would have a composition of either *HH* or *Hh*, and a normal male would be of the composition *hh*. Females would have the possible compositions *hh*, *Hh*, or *HH*, all of which would be phenotypically normal, but genotypically the latter two would carry the factor for hernia. The phenotypes of the three possible genotypes would be as follows:

Genotypes	*Phenotypes (male)*	*Phenotypes (female)*
HH	Herniated	Normal
Hh	Herniated	Normal
hh	Normal	Normal

If, however, the one herniated female reported was the result of expression of hereditary factors rather than the result of causes other than heredity, then another hypothesis is indicated. In this case the herniated female would probably be homozygous for the hernia factor. The factor for hernia, *H*, would then be dominant in males, but recessive in females; and the factor for normal, *N*, would be just the reverse, that is dominant in females and recessive in males. According to this hypothesis *HH* and *HN* males would be herniated and *NN* males would be normal, while *NN* and *HN* *females* would be normal and *HH* females would be herniated. All sons of herniated females would be herniated, and all daughters would carry the hernia factor, but it would not be expressed in the latter unless sired by a herniated male.

The herniated female III-39, a daughter of sire *B*, has produced only one calf, a herniated son, IV-26. This does not prove either hypothesis. According to the first hypothesis this calf could be *Hh*, the result of mating a normal male, *hh*, with a heterozgous female, *Hh*. Based on the second hypothesis the calf could be *HN*, the result of mating a normal male, *NN*,

with a herniated female, *HH*. If in the future herniated female III-39 produces a normal son sired by a normal male, the second hypothesis will be disproved and the first probably be correct; namely, that heritable hernia is limited to males.

Practical Application

Evidently umbilical hernia is not a serious problem in the breeding of dairy cattle or it would have been more universally present and recognized than seems to be the case. If noticed, there would probably be a tendency among breeders to discard animals with this defect. The fact that it has not cropped out more often in a large number of herds, therefore, would seem to strengthen the belief that it is probably a dominant character. If it were a recessive character it would become more universally distributed among cattle in spite of selection against it, and would be more difficult to eliminate.

Should complete genetic analysis prove umbilical hernia to be a dominant character, cattle breeders could control the occurrence of the defect by the continuous use of normal males. The only possibility for hernia to appear would then be through females that carry the hernia factor. In this situation selection and sequence of generations would continually reduce the occurrence of hernia.

Summary and Conclusions

1. An unusually large number of male calves with umbilical hernia appeared in two herds in which the same herd sire had been used.

2. Twenty-one herniated animals observed in three herds were descendants of one common ancestor, and since no animals not descendants of this ancestor were found to be herniated, there is little doubt that the character is inherited.

3. The defect seems to be sex-limited.

4. Hernia appears to be a dominant character in males, but in females the mode of inheritance is questionable.

5. The limited data indicate that hernia is inherited in a simple Mendelian fashion and may be due to one of a pair of autosomes carrying a sex-limited factor for hernia.

Table I—Data on Herniated Calves

Index No. of Calf	Herd Index	Sire Index	Age When Hernia Appeared (weeks)	Age When Hernia Disappeared (weeks)	Diameter Hernial Ring (c.m.)	Diameter Hernial Sac (c.m.)	Texture
III 17	1	B	2	Operated upon: 12			
III 18	1	B		killed 2			
III 19	1	B		present at 6 yrs.			soft and pliable
III 20	1	B		19			
III 21	1	B		present at 24			
IV 16	1	C	2	present at 26	3	8-10	firm to soft
V 4	1	C	2	18	2	4- 6	soft and pliable
IV 15	1	C	3	present at 20	2	5- 7	soft and pliable
IV 25	1	C	2	10	1½	3- 4	soft and pliable
V 1	1	E	2	12	2	4- 5	soft and pliable
IV 5	1	E	2	28	3	6- 8	soft and pliable
IV 6	1	E	birth	present at 10	2	4- 6	firm to pliable
IV 7	1	E	1	22	3	8-10	soft and pliable
VI 1	1	E	1	present at 11	3	5- 6	variable, firm to pliable
III 35	2	B			Large		
III 36	2	B					
III 37	2	B			Large		
III 38	2	B			Small		
IV 26	2	III 32					
IV 27	3	D		present at 20		7- 8	

Literature Cited

1. Davenport, C. B. Heredity in Relation to Eugenics, Henry Holt and Company, New York City, 1911. P. 298.

2. Dollar, A. W. Regional Veterinary Surgery, William R. Jenkins, New York City, 1912. Pp. 521, 531, 552, and 566.

3. Ferguson, A. H. The Technic of Modern Operations for Hernia, Cleveland Press, Chicago, 1907. P. 10.

4. Hadley, F. B., and Warwick, B. L. Inherited Defects of Livestock, *Journal of American Medical Association*, Vol. IXX, new series, Vol. 23, No. 4, 1927.

5. Law, James. Text Book of Veterinary Medicine, James Law, Ithaca, 1905. P. 379.

6. Murray, A. J. Diseases of Cattle, Government Printing Office, Washington, 1923. Pp. 39-40.

7. Sajous, C. E. de M. Sajous's Analytic Cyclopedia of Practical Medicine, F. A. Davis Company, Philadelphia, 1925. P. 451.

8. Stengel, A., and Fox, H. A Text Book of Pathology, W. B. Saunders Company, Philadelphia and New York, 1921, seventh edition. P. 657.

9. Van Herwerden, M. A., and Laugh-

LIN, H. H. Standard Pedigree Charts, *Journal of Heredity,* 1926, Vol. 17, No. 8.

10. VON BERGMANN, E., VON BRUNS, P. and VON MIKULICZ, J. A System of Practical Surgery, Lee Brothers and Company, New York and Philadelphia, vol. IV, Pp. 612-613.

11. WARWICK, B. L. A Study of Hernia in Swine. *Wis. Agr. Expt. Sta. Res. Bulletin 69,* 1927. Pp. 4, 5, 11, 22, and 25.

12. YOUATT, W. The Pig, Philadelphia, 1847. P. 175.

From Ape to Man

UP FROM THE APE, *by* EARNEST ALBERT HOOTON, Professor of Anthropology, Harvard University. Pp. 626. Price $5.00. Many illustrations. New York, Macmillan Co. 1931.

FROM the pen of an author so erudite the matter of the text is, as would be expected, above reproach. This is particularly true of the well established facts with which the volume is replete. In the closing pages the author in attempting to establish the cause and method of evolution, becomes rather less orthodox and more speculative; however at least one foot is always kept on the solid ground of the mutation theory, though that of the continuity of the germ plasm does receive some criticism and perhaps after all the best answer to the query which heads this last and contentious section ("Why has man evolved?") is that given in the next line of the text—"Nobody knows!" The other possible answers are at least clearly stated. The illustrations are good and well chosen, and aptly illustrate the text.

The method is a grouping of material into several parts:—

Part I. First indicating the difference between analogies and homologies follows Huxley in a dispassionate consideration of homologies which, by a process of elimination classifies a human cadaver as a Primate, the eliminative reasoning indicating the essential differences between man and those animals grouped as his relations.

Part II. The Primate life cycle after a brief geological review, develops in turn the evolution of the vertebrae, locomotion, hearing, smelling and handling in their relative importance to an animal of arboreal habit. Standing up and looking around, becoming erect, walking (the bipedal stage), the correlation existing between the acquisition of tools and absence of so great a necessity for further structural modifications, the development of the brain with an interesting résumé of what are virtually I. Q. tests for anthropoids, talking, the growth of the teeth, the loss of hair, and in general an extensive survey of human evolution in which contentious matters have been handled with caution, completes this part of the book. The discussion is marked by an entire absence of dogmatism and an aptly expressed realization of the necessity for one to be "on one's guard against those who readily evolve an entirely new species out of a new habit" (P. 143).

Part III. The individual life cycle, in its first phase, carries the reader quickly through a synopsis of higher mammalian embryology in which the recapitulation theory is discussed as are the many instances of similarities found during the fetal life of man and the higher apes. In the author's concluding paragraph, he expresses his opinion "that there is no real doubt that the evidence of embryological development by itself is enough to establish the kinship of man with the primates and his most intimate relationship with the great apes" (P. 238).

In its second phase, Part III, dealing with growth, sex differences, marital habits, birth, getting old and dying in both man and the apes, becomes rather physiological, in parts almost gynecological.

Part. IV. Embraces the fossil ancestors of man, and under this section head are discussed the various skeletal

parts of discovered prehistoric men in the search of cultural facts and sequences in so far as they enable us to determine chronological successions.

Part V is more systematic. In it race differences are tabulated and classified. The chapter includes an interesting discussion of blood groups and racial disease resistances and concludes the volume with the controversial matter already referred to.

The manner of the text is terse with short sentences of well chosen words, a commendable style, particularly for a subject which lends itself to much tabulation.

The author has undoubtedly succeeded in the aim outlined in his preface—the production of an *authoritative* text capable of being read and understood by those not as yet trained in geology, biology, anatomy, or anthropology. To such persons, requiring an excellent and in the main orthodox résumé of these sciences and especially the three last named, the book is strongly recommended.

R. B. Kelley.

"FOR EVERY CHILD"—THE TWENTIETH PLEDGE

The Children's Charter

PRESIDENT HOOVER'S WHITE HOUSE CONFERENCE ON CHILD HEALTH AND PROTECTION,
RECOGNIZING THE RIGHTS OF THE CHILD AS THE FIRST RIGHTS OF CITIZENSHIP,
PLEDGES ITSELF TO THESE AIMS FOR THE CHILDREN OF AMERICA

I For every child spiritual and moral training to help him to stand firm under the pressure of life

II For every child understanding and the guarding of his personality as his most precious right

III For every child a home and that love and security which a home provides; and for that child who must receive foster care, the nearest substitute for his own home

IV For every child full preparation for his birth, his mother receiving prenatal, natal, and postnatal care; and the establishment of such protective measures as will make childbearing safer

V For every child health protection from birth through adolescense, including: periodical health examinations and, where needed, care of specialists and hospital treatment; regular dental examinations and care of the teeth; protective and preventive measures against communicable diseases; the insuring of pure food, pure milk, and pure water

VI For every child from birth through adolescence, promotion of health, including health instruction and a health program, wholesome physical and mental recreation, with teachers and leaders adequately trained

VII For every child a dwelling-place safe, sanitary, and wholesome, with reasonable provisions for privacy; free from conditions which tend to thwart his development; and a home environment harmonious and enriching

VIII For every child a school which is safe from hazards, sanitary, properly equipped, lighted, and ventilated. For younger children nursery schools and kindergartens to supplement home care

IX For every child a community which recognizes and plans for his needs, protects him against physical dangers, moral hazards, and disease; provides him with safe and wholesome places for play and recreation; and makes provision for his cultural and social needs

X For every child an education which, through the discovery and development of his individual abilities, prepares him for life; and through training and vocational guidance prepares him for a living which will yield him the maximum of satisfaction

XI For every child such teaching and training as will prepare him for successful parenthood, home-making, and the rights of citizenship; and, for parents, supplementary training to fit them to deal wisely with the problems of parenthood

XII For every child education for safety and protection against accidents to which modern conditions subject him—those to which he is directly exposed and those which, through loss or maiming of his parents, affect him indirectly

XIII For every child who is blind, deaf, crippled, or otherwise physically handicapped, and for the child who is mentally handicapped, such measures as will early discover and diagnose his handicap, provide care and treatment, and so train him that he may become an asset to society rather than a liability. Expenses of these services should be borne publicly where they cannot be privately met.

XIV For every child who is in conflict with society the right to be dealt with intelligently as society's charge, not society's outcast; with the home, the school, the church, the court and the institution when needed, shaped to return him whenever possible to the normal stream of life

XV For every child the right to grow up in a family with an adequate standard of living and the security of a stable income as the surest safeguard against social handicaps

XVI For every child protection against labor that stunts growth, either physical or mental, that limits education, that deprives children of the right of comradeship, of play, and of joy

XVII For every rural child as satisfactory schooling and health services as for the city child, and an extension to rural families of social, recreational, and cultural facilities

XVIII To supplement the home and the school in the training of youth, and to return to them those interests of which modern life tends to cheat children, every stimulation and encouragement should be given to the extension and development of the voluntary youth organizations.

XIX To make everywhere available these minimum protections of the health and welfare of children, there should be a district, county, or community organization for health, education, and welfare, with full-time officials, coordinating with a state-wide program which will be responsive to a nation-wide service of general information, statistics, and scientific research.

This should include:

(a) Trained, full-time public health officials, with public health nurses, sanitary inspection, and laboratory workers

(b) Available hospital beds

(c) Full-time public welfare service for the relief, aid, and guidance of children in special need due to poverty, misfortune, or behavior difficulties, and for the protection of children from abuse, neglect, exploitation, or moral hazard

FOR EVERY CHILD THESE RIGHTS, REGARDLESS OF RACE, OR COLOR, OR SITUATION, WHEREVER HE MAY LIVE UNDER THE PROTECTION OF THE AMERICAN FLAG

The White House Conference was a very inspiring undertaking and very productive of good. The actual flower, as it were, the Conference itself, lasted only three days, but the committee reports presented there, and the continuing activities there initiated were a very remarkable evidence of long-term interest in our greatest asset—our children. There can be no question that much was done, and that much is being done to improve conditions of children, and this should benefit the race.

Still, in the face of the facts presented at the conference, it is peculiar, nay almost incredible, that the fundamental right of childhood is ignored. In his opening address President Hoover presented these statistics of our 45,000,000 children:

35,000,000 are reasonably normal
6,000,000 are improperly nourished
1,000,000 have defective speech
1,000,000 have weak or damaged hearts
675,000 present behavior problems
450,000 are mentally retarded
382,000 are tubercular
342,000 have impaired hearing*
18,000 are totally deaf
300,000 are crippled
50,000 are partially blind
14,000 are wholly blind
200,000 are delinquent
500,000 are dependent

* This figure in President Hoover's speech, due to later findings of the Committee, was increased to 3,000 000.

Of the nine million somehow afflicted, and the estimate is low (Report of Committee on Physically and Mentally handicapped† gives 2,500,000 with well marked behavior difficulties and 6,500,000 mentally deficient) what proportion can be materially benefitted by any ameliorative program, however well intentioned, and however expensive to the taxpayer? Opinions differ, but tak-

† White House Conference, 1930. The Century Company, New York. P. 293.

ing a conservative figure of 50% due to hereditary defects, is it not a travesty to put forth a bill of rights for childhood, and not to acknowledge the fundamental right *of a sound body and a sound mind?*

Probably the conference felt such a plank trespassed on two basic rights of adults—to procreate and to emotionalize, and that treading on this forbidden ground would interfere with the unanimity that appeared to pervade the conference. Without a recognition of the inalienable right to a sound body and a sound mind, are not these other privileges simply meaningless abstractions? With the above figures in mind, a reading of some of the pledges in the Charter savors almost of the sardonic. Education for parenthood, for every one of our six million mental deficients! Did the Conference *really believe* that to be right, kind, or in the interests either of the child or of society? For every child—a home environment harmonious and enriching, (with parents suffering from, and transmitting, heritable defects that make such a wish a travesty!) We learn that the Golden Rule is the basis of the Children's Bill of Rights; that, while the Golden Rule does not refer to vaccination or to pure milk, it *means* these things today. Does it not also include a mandate to prevent the procreation of crooked bodies and warped minds, and is any childhood charter adopted today deserving of respect that ignores these facts?

Perhaps it is too much to expect that this conference should have considered the aspect of heredity in child welfare. There is admittedly enough to be done on the environmental side to keep several conferences busy. The subject of human heredity is broad enough to be considered by a separate gathering. There are ample data available to make possible some very definite recommendations. Shortly after the Conference adjourned, Dean Lyon of the Medical School of the University of Minnesota suggested that such a conference should be called,* to study and to recommend ways of applying existing knowledge regarding human heredity for the benefit of the race. The absence of the fundamental pledge from those adopted by the last conference makes it imperative that action be taken to ratify and to make effective the most important childhood right of all—*"For every child the right to be well born."*

Until this is generally recognized by doctors, by welfare workers and by educators, the great interest and the very heartening interest in child welfare which the conference showed to exist will be in danger of being misdirected or even of being warped to ends detrimental to the race.

A German Eugenics Text Translated

BAUR, E., FISCHER, E., and LENZ, F., *Human Heredity*. Translated by EDEN and CEDAR PAUL. New York, Macmillan, 1931. pp. 734.

FOR several years I have hoped that someone would translate the valuable work of Baur, Fischer and Lenz on "Menschliche Erblichkeitslehre." Recently Eden and Cedar Paul have added this work to their long list of German volumes which they have rendered into English. It is to be hoped that they will put American students of heredity and eugenics still further in their debt by translating the companion volume to this work, i.e., "Menschliche Auslese und Rassenhygiene (Eugenik)" by Dr. Fritz Lenz. In fact, these two books are really parts of one general treatise. The translation was made from the third German edition printed in 1927. The first edition appeared in 1921. In each of the three editions which have

* The White House Conference and Heredity. JOURNAL OF HEREDITY, 22:92. 1931.

been published in the short interval of six years, there have been numerous additions and modifications to keep the work reasonably abreast of the times. Considering the labor involved in translating such a work, it is almost sad to think that a revised edition will be needed a few years hence. Nevertheless, we have in this volume a body of knowledge which will constitute a valuable sourcebook for many years to come, even if knowledge of the subject increases at an accelerated pace, as it doubtless will.

From the nature of the case, much of our information concerning human heredity will have to be gathered from the experiences of medical men with their patients. At present, the average medical practitioner knows little of genetics. Medical students are fortunate if they pick up a rudimentary knowledge of Mendel's law during their premedical course. In the later grind of regular medical instructiton they will probably have few opportunities to make good their deficiencies, even if they should appreciate the importance of so doing. The more medical men there are who have some training in genetics the more opportunities for gathering, interpreting and recording facts on human heredity will be seized, and the more rapidly our knowledge of this subject will be extended. The publication of Baur's, Fischer's and Lenz' work, by enabling medical men to become acquainted with the more important facts and principles of human heredity, will doubtless perform a valuable service in stimulating further observation and research.

Section I of the book, by Dr. E. Baur, consists of a sketch of the general theory of variation and heredity. Dr. E. Fischer contributes the second section on Racial Differences in Mankind, which will be of especial interest to the anthropologist. The third section on Morbific Hereditary Factors, by Dr. F. Lenz, is the longest in the volume and gives descriptions, illustrated with many pedigree charts, of most of the heritable human defects and predispositions to disease which are now recognized. The various biometric and other methods employed in the study of human heredity are described by Dr. Lenz in Section IV on Methodology.

The final section of the book, also by Dr. Lenz, is devoted to The Inheritance of Intellectual Gifts. In recent years many fruitful researches have been carried on upon the transmission of superior mental ability, and it is helpful to have a résumé of the results. The attempt to evaluate the mental differences between the races of man, and especially between the subdivisions of the Caucasion race, will doubtless arouse quite different reactions from different readers. The field is full of pitfalls, and much that is written on it, while suggestive, is lacking in conclusiveness.

We hope that the price ($8.00) will not unduly restrict the dissemination of this very valuable work. As it is desirable that the book have a wide sphere of usefulness we may suggest, with all diffidence, that, after the universities and the chief libraries are provided for, the price be reduced to,—say, $4.95.

S. J. Holmes.

Maize in South Africa

MAIZE IN SOUTH AFRICA, by A. R. Saunders. Pp. 284 £1 net. South African Central News Agency, Johannesbury, 1930.

ALTHOUGH Indian corn is one of the principal cereals and hence one of the world's most important food plants, books on the crop are not numerous. Maize in South Africa makes a welcome addition to the short list and compares favorably with the product of U. S. authors.

Naturally, written for an African audience the book contains much information of only casual interest to

American readers. Most of the general information such as origin, history, genetics, pathology, breeding methods and uses originated in the U. S. However, this very fact makes the book of some value to readers in the Western Hemisphere.

It is of interest to note that maize reached South Africa as early as 1655. Despite this long period of residence the plant apparently is not happy, for South Africa has the rather unenviable distinction of having the world's worst corn yields. It would be interesting to know whether this poor showing is due to generally unfavorable conditions or to lack of acclimatization. One can not help wondering whether the native African sorghums yield more or less in Africa than in the United States.

Transplanted to Africa, maize encountered some new adversaries. One of these, the witchweed (*Striga lutea*), in addition to being a serious parasite offers a fascinating problem in physiology. Witchweed is a flowering plant that behaves as an annual on annual hosts and one that, under favorable conditions, will produce 2 or 3 million seeds which probably will remain viable in the soil for 20 years. The author states that the seeds of this plant do not germinate in the absence of a host plant. "Experiments have shown that an activating substance is exuded from or excreted by the roots of the host plants, and that in the absence of a host, and therefore of this substance, the seeds will not germinate. All attempts at inducing germination artificially have hitherto given negative results. What this activating substance is and how it acts have not been established; all that is known concerning it is that it is easily inactivated by heat or by exposure for more than 48 hours. It is exuded by members of the grass family only, but not by all of them." Apparently South Africans are not troubled with the European corn borer (*Pyrausta nubilalis*) but they have an able substitute in the African borer (*Busseola fusca*) which seems to have much the same habits as his European cousin.

It is of interest also to note that most of the rots attracting attention in the United States are present in South Africa and that tassel smut (*Sorosporium reilianum*) is of more importance than the ear smut (*Ustilago zeae*)

The book is divided into thirteen chapters of which one is devoted to a description of the principal varieties showing that the theory of improvement through inbreeding has not attained the status of an epidemic in Africa. There is an index and bibliography of 142 original sources.

J. H. Kempton.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the reader of the Journal *will be reviewed in later numbers.*

BIOLOGY AND MANKIND, *by* S. A. McDowell, B. D., Senior Chaplain and Senior Science Master at Winchester College. Pp. 229. 9 Chapters. 46 Illustrations. Price, $2.50. New York, The MacMillan Co., 1931.

From the Preface: "The greatest need of England, and England's politicians is knowledge of the biological factors upon which legislation may impinge." Unfortunately biological factors don't have a vote, and the next election is nearer than the F_1.

WEEDS IN THE GARDEN OF MARRIAGE, *by* Captain George Pitt-Rivers. Pp. xv and 86. Price, 3/6. London, Noel Douglas. 1931.

There is real segregation in Anthropologists. Either they don't believe in heredity, or they do. Captain Pitt-

Rivers does, and right good reading, too.

MENDELISM AND EVOLUTION, *by* E. B. Ford, M. A., B. Sc., University Demonstrator in Zoology and Comparative Anatomy, Oxford. Pp. 116. Price, $1.50. New York, Lincoln MacVeagh—The Dial Press. 1931.

So that he who runs may read of genes and chromosomes and other things.

INTERNATIONAL MIGRATIONS, Volume II. Interpretations. By a Group of Scholars in Different Countries. Edited on Behalf of the National Bureau of Economic Research, Inc., *by* Walter F. Willcox. Pp. 715. 20 Chapters, III Parts. 270 Tables, 22 Diagrams. Price, $7.00. New York, National Bureau of Economic Research, Inc. 1931.

A billion and a half of us, and migratious, what a lot of running around we seem to have done.

A THOUSAND MARRIAGES, A Medical Study of Sex Adjustment, *by* Robert Latou Dickinson and Laura Beam, with an Introduction by Havelock Ellis. Prepared under the Auspices of The National Committee on Maternal Health. Price, $5.00. Baltimore, Williams & Wilkins. 1931.

A gynecologist, who is at heart an artist, goes into statistical and case-history retrospect as to how his patients have solved or muddled vital problems of their lives.

THE MENTAL DEFECTIVE, A Problem in Social Inefficiency, *by* Richard J. A. Berry, M. D., F. R. C. S., F. R. S. E., and R. G. Gordon, M. S., D. Sc., F. R. C. P. E. Pp. 225. 8 Chapters. Price, $2.50. New York, Whittlesey House, McGraw-Hill. 1931.

An English view of one of the most disquieting, and certainly the most pathetic, parts of the human race.

ANIMAL AGGREGATIONS, A Study in General Sociology, *by* W. C. Allee, Professor of Zoology, University of Chicago. Pp. 431. 20 Chapters. Price, $5.00. Chicago, University of Chicago Press. 1931.

First we migrate. Then we aggregate. This aggregating does queer things to living organisms, as Professor Allee ably shows. Then we get civilized. Then we *have* to do something so we migrate some more, and so it goes.

THE NEW ROAD TO CIVILIZATION, *by* H. G. Baker, Professor of Biology, Dakota Wesleyan University, Mitchell, S. Dakota. Volume I, 150 pp. Price, $1.50. Volume II, 170 pp. (Mimeographed). Price, $1.70. Economy Publishers, Seattle, Wash. 1931.

The New Road is paved with genes. It is lighted by biological research and experimentation. Professor Baker adds, in lieu of billboards, a symposium of poetry on Evolution—some new to us, and *some* not bad at all.

"Informing the Dear Public"

J. W. Sprowles, psychologist (listed in American Men of Science), gives a low-down on this heredity business, syndicated in the Washington Star, and undoubtedly elsewhere.

The most striking fact about human beings is to be observed in their individual differences. How can these differences be accounted for?

One theory is that individuals differ because they are born different. This is the famous heredity theory. Your attitude toward this theory is pretty likely to be determined by your respect, or lack of respect, for your ancestry. I know of nothing about which the average person is more likely to form a mental complex.

As a matter of fact, few of us know very much for certain about our ancestry. You might try to write a biography of your great-grandfather just as a test of what you know about your hereditary make-up.

The hereditary theory as an explanation of individual differences is fast losing its prestige. It is being replaced by the theory that we are what we are because of our surroundings. And the most important of our surroundings are our habitual human associates. Many a character has been made on the school playgrounds. For the most part our real character traits are about what they were at 20. If you would like to make yourself over, change your associates. Put yourself in competition with strong, clear-thinking people, and your old friends will not know you after awhile.

And that's that!

Putting paragraph 2 and two together one might suspect that our author has recently invested in a family tree, and found several ancestors hanging on it, and not by their tails.

A CHIMERA IN THE POINSETTIA

In a previous number of this JOURNAL* there was given an account of a pink Poinsettia chimera occurring in Florida. The partial reversion of some pink flowering plants to the common red form, following a freeze, gave rise to the occurrence of both pink and red flowering stems arising from the same root stock. A recent inspection of some of these plants disclosed one stem that combined the red and pink bracts in its terminal blossoms, the chimeral nature being so sharply defined that *one bract was pink on one side and red on the other side of the midrib*. This is clearly shown in the illustration. The stem which bore this flower cluster showed a clear line of demarcation between the two tissues giving rise to the different colors in the blossoms, the bark of the segment producing red bracts being a purplish green, while the other half of the stem was of a light green color. The flower had in all 24 bracts, 13 of them pink, 10 red, and one divided as described. This stem is being propagated from cuttings and should result in some interesting chimeral combinations.

T. RALPH ROBINSON.

*T. RALPH ROBINSON, and GEO. M. DARROW. A Pink Poinsettia Chimera. *Journ. of Heredity*, XX,No. 7, July, 1929, page 334-339.

A NORMAL SPECIMEN OF THE JAPANESE MORNING GLORY

Figure 14

The normal or original Japanese morning glory, from which numberless varieties have appeared under cultivation. The leaves are three-lobed and flowers open in a funnel-shape, with a dilute blue color. This species has been grown as an ornamental in Japan and China for over 2,000 years. It is found today only under cultivation. Genetic studies have brought to light over a hundred mendelian characters, of which only fifteen are dominant to the normal.

NEW MUTANT CHARACTERS OF THE JAPANESE MORNING GLORY

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DURING some fifteen years' investigation of the Japanese morning glory, *Pharbitis nil*, I have noticed a number of new mutant characters, some of which were described in my earlier papers.[2, 3, 5, 6] Meanwhile, two other mutant characters were reported by Hagiwara[1] and Miyazawa[7]. According to personal information, Mr. C. U of Kónosu Experiment Station has been studying several mutant forms which appeared under his observation. In this paper, I intend to present a description of five new mutant characters, reserving the others for future publication.

Though mutations, in general, make their rare and sporadic appearance, one class of mutations occurs frequently in a definite proportion. In the latter case, the variations are induced by certain mutable genes, which alter at intervals in one and the same direction. In the Japanese morning glory, the mutants produced by mutable genes are generally normal in type, reverting to their prototype (Figure 14). Willow, however, reverts to maple and not to normal, but maple is one of the common variations in this plant. Therefore, mutable genes give no new characters. Quite contrary to this, sporadic mutations frequently give new traits. The five mutations, of which I am going to describe, brought about new characters by their occurrence.

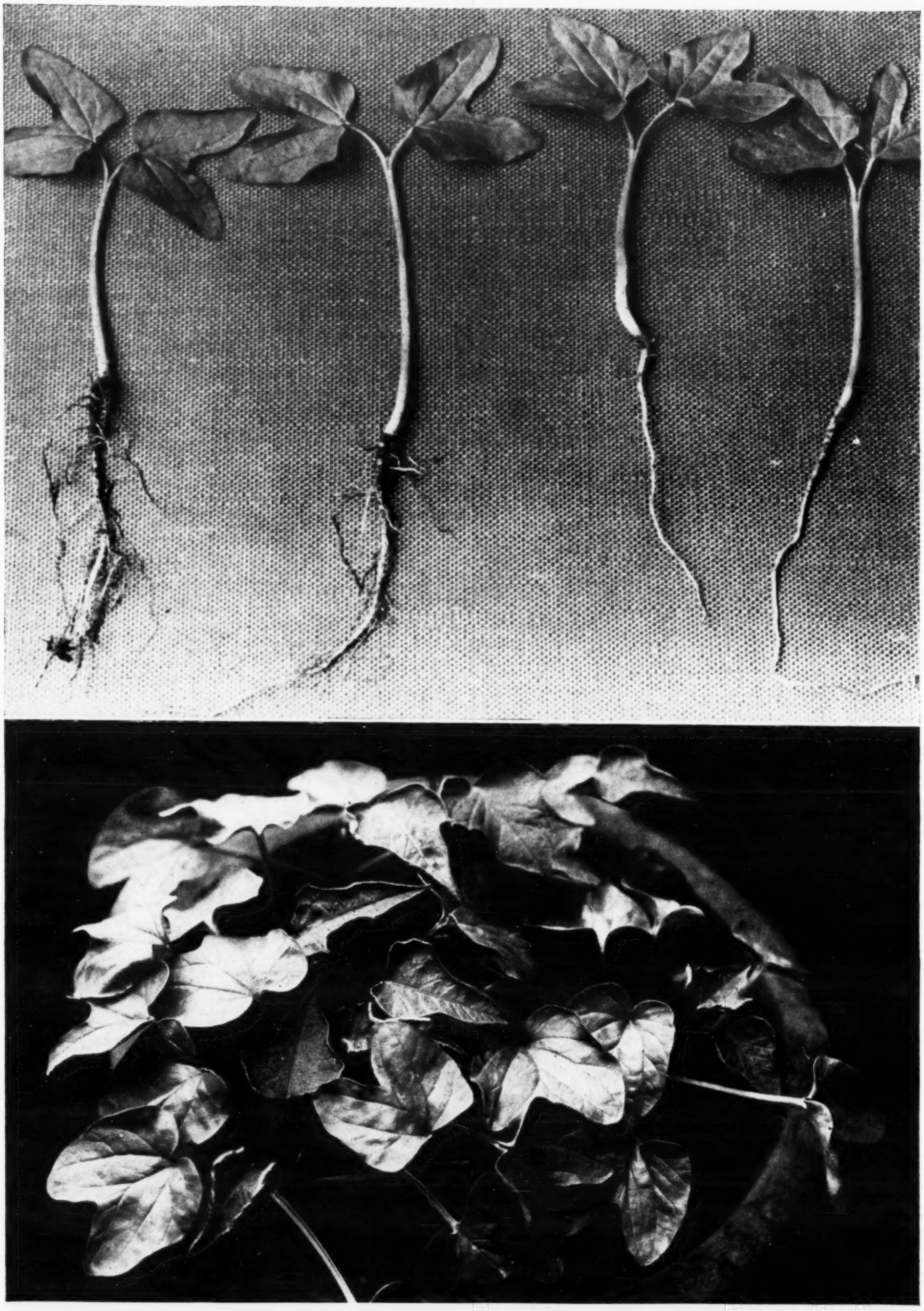
Rootletless

One of the five pedigrees of No. T7, bred in 1927, contained some seedlings with a peculiar root system. The seedlings had no rootlets in their early stage after germination (Figure 15), so that the new character is called rootletless. Twenty-nine rootletless seedlings appeared among a total of 202, the sister seedlings being normals with numerous slender rootlets (Figure 15). Previously I had observed only normal seedlings in this strain (No. T7), and therefore the rootletless character is considered to have appeared by mutation. The succeeding generation was raised in 1929. Three rootletless plants bred true for the abnormality, giving 64 rootletless seedlings in all. Of the nineteen sister normals, ten plants bred true to normal, and nine segregated rootletless seedlings as recessives. The segregations occurred in the ratio of 885 normal and 177 rootletless seedlings in total, giving 16.7 percent of recessive rootletless. The deficiency of rootletless segregates was also observed in 1927 when this mutant character made its appearance; namely, 14.4 percent. The low ratio of the rootletless segregates cannot be passed over and this is the subject of another experiment now in progress. Aside from this, the rootletless character is a simple recessive to normal.

Rootletless seedlings generally have cotyledons with shallow lobing (Figure 15). Later in the seedling stage, however, numerous thick and crooked rootlets appear (Figure 16), and the plants grow up vigorously, but they never become as luxuriant as normals. Hairs growing over the plant body, such as the stem, petiole, leaf, peduncle, calyx, etc., are remarkably short, appearing to have been clipped off (Figures 15 and 16).

Folded

A new mutant character folded appeared in the mutant rootletless

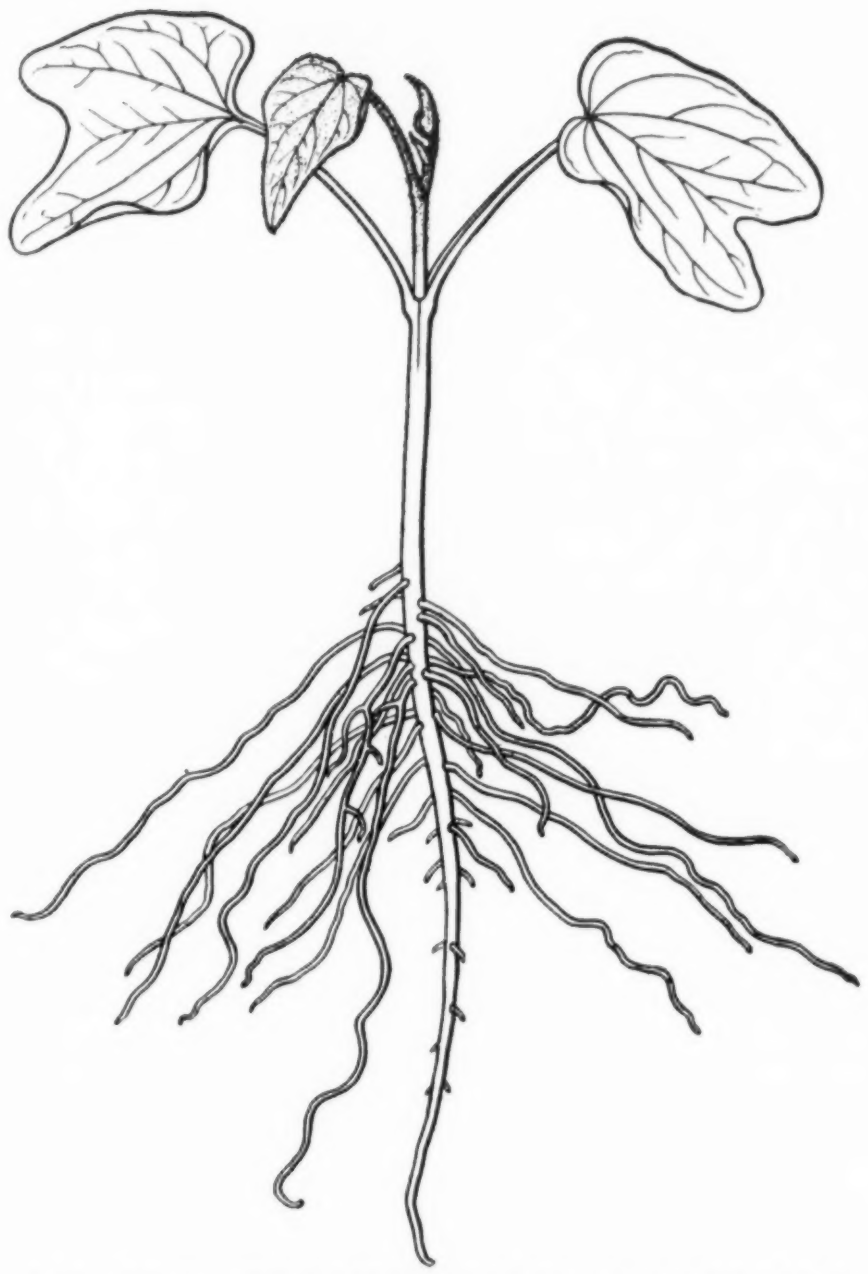


NORMAL AND ROOTLETLESS SEEDLINGS

Figure 15

Rootless seedlings (two at right, above) are compared with normal seedlings (left). Rootless appeared by mutation as recessive segregates in a normal family. In the photo, the slender rootlets of the normal seedlings are withered and somewhat crooked in form.

Below is shown a pot of rootless seedlings; the cotyledons generally have shallow lobes. The leaf hairs are remarkably short, and appear as though they had been clipped off.



AN OLD ROOTLETLESS SEEDLING WITH ROOTLETS

Figure 16

Rootless seedlings bear thick and crooked rootlets in their later growth. Note the extremely short hair on the foliage. These seedlings produce plants that do not become as large as normal plants.

strain. In 1930 three folded mutants made their appearance among fifteen rootletless plants. The new character is named by the flowers remaining closed all through their existence (Figure 17). The flower-buds grow to normal size, but they never open, but fall from the plant when the folded flowers turn yellow. The pistils are apparently normal, but quite sterile, even when hand-pollinated by normal pollen. Stamens are apparently also normal containing some pollen-grains, but without shedding them. The new mutant character was segregated as a recessive from normal mother plants, which were evidently heterozygous for folded.

Pigmy

In 1929, I bred 124 pedigrees of strain SK6 to examine the mutability of the flecked character. One of them gave nine peculiarly dwarf seedlings called pigmy in a total of 59, the sister seedlings were quite normal. The cotyledons of the mutant pigmy seedlings are small in size and hard in texture, curved backwards and of a deep green color. Between two cotyledons, which are attached to the hypocotyl with very short stalks, there appear a few crumpled leaves with very short petioles (Figure 18). The seedlings do not grow beyond this stage, even when they are carefully tended. In the succeeding generation of the sister normal plants, ten segregating pedigrees contained a total of 160 normal and 45 pigmy seedlings, showing a simple assortment with a deficiency of the pigmy seedlings, which have low viability.

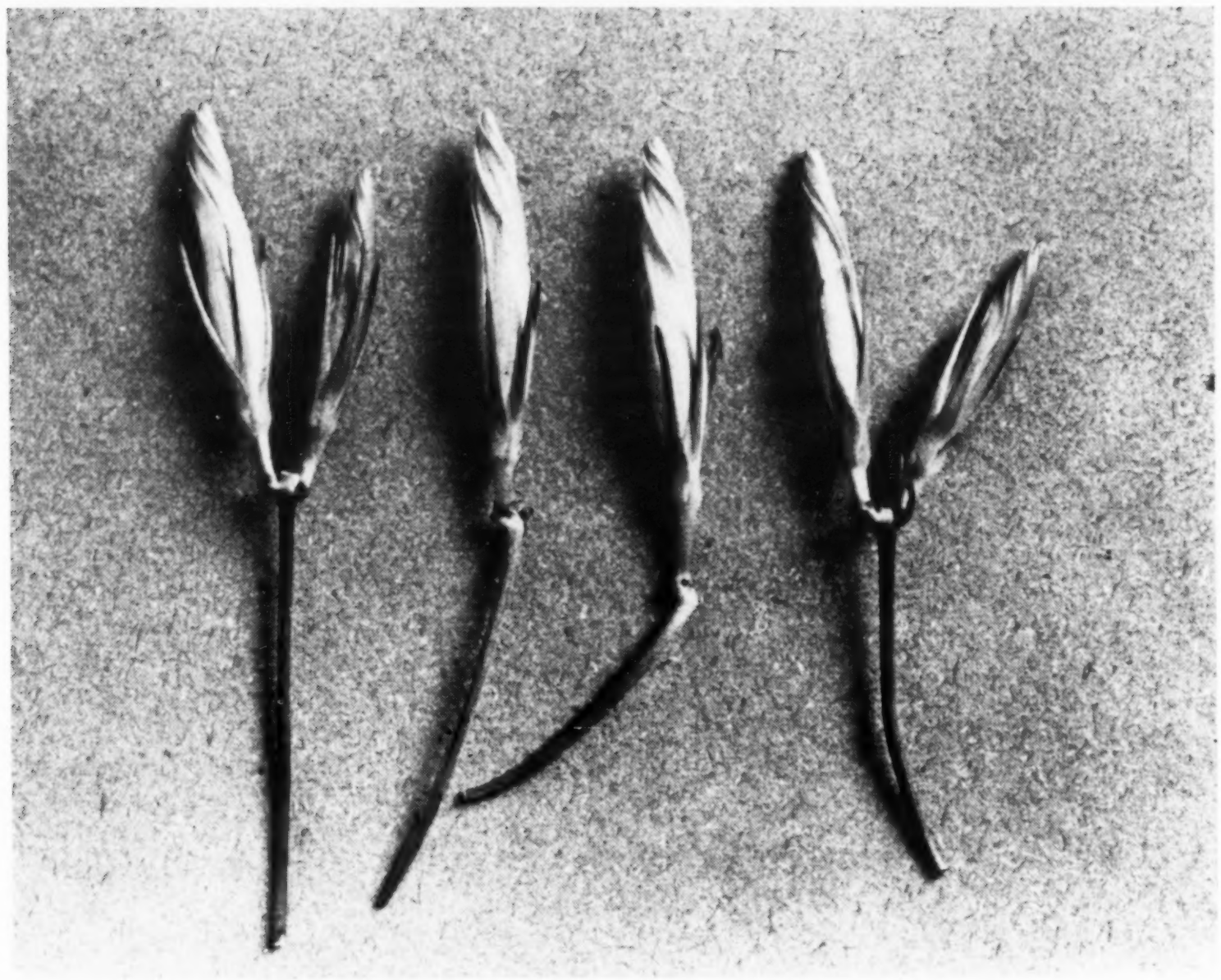
Cocoa

In 1929, cocoa seeds were collected on three plants of an albescent strain, the twelve sister plants producing normal black seeds. The cocoa seeds occurred quite suddenly as recessive mutants. The color of the cocoa seeds is "dark brown," being intermediate between chocolate and brown in the seed-color variations of this plant.

Shrubby

In 1929, one of the four F_2 families obtained by cross 471×450 gave fourteen shrubby, the 53 sister plants being normal (Figure 19). The shrubby character was segregated as a simple recessive to normal and bred true to the character in 1930.

The manifold manifestations of the gene shrubby are as follows: Somewhat small seedlings; branches appearing from the lower part of the main stem; lobes of the leaf sharp-pointed and somewhat hard in texture (Figure 20); the flower normal in type. All these characters are transmitted *en masse,* and represent collectively the shubby character. By



FOLDED FLOWERS AND FLOWER-BUDS

Figure 17

Folded flowers made their appearance as recessive mutants in a rootletless family. The flowers turn yellow in color later in their existence, and then fall off, without opening. The photo shows six flowers and flower-buds, of which the second (from the left) and the sixth are flower-buds, the fifth corresponds to a flower just blooming and the others are old folded flowers. Note the vestiges from which withered flowers have dropped.

PIGMY SEEDLINGS

Figure 18

Pigmy is a very dwarf form which occurred by one-gene mutation under observation. Cotyledons are small, curved backwards and of a deep green color. A few small and crumpled leaves appear between the cotyledons. Cotyledons and leaves have very short stalks, therefore the foliage is crowded on a short hypocotyl. It does not grow beyond this state.

NORMAL AND SHRUBBY PLANTS IN BLOOM

Figure 19

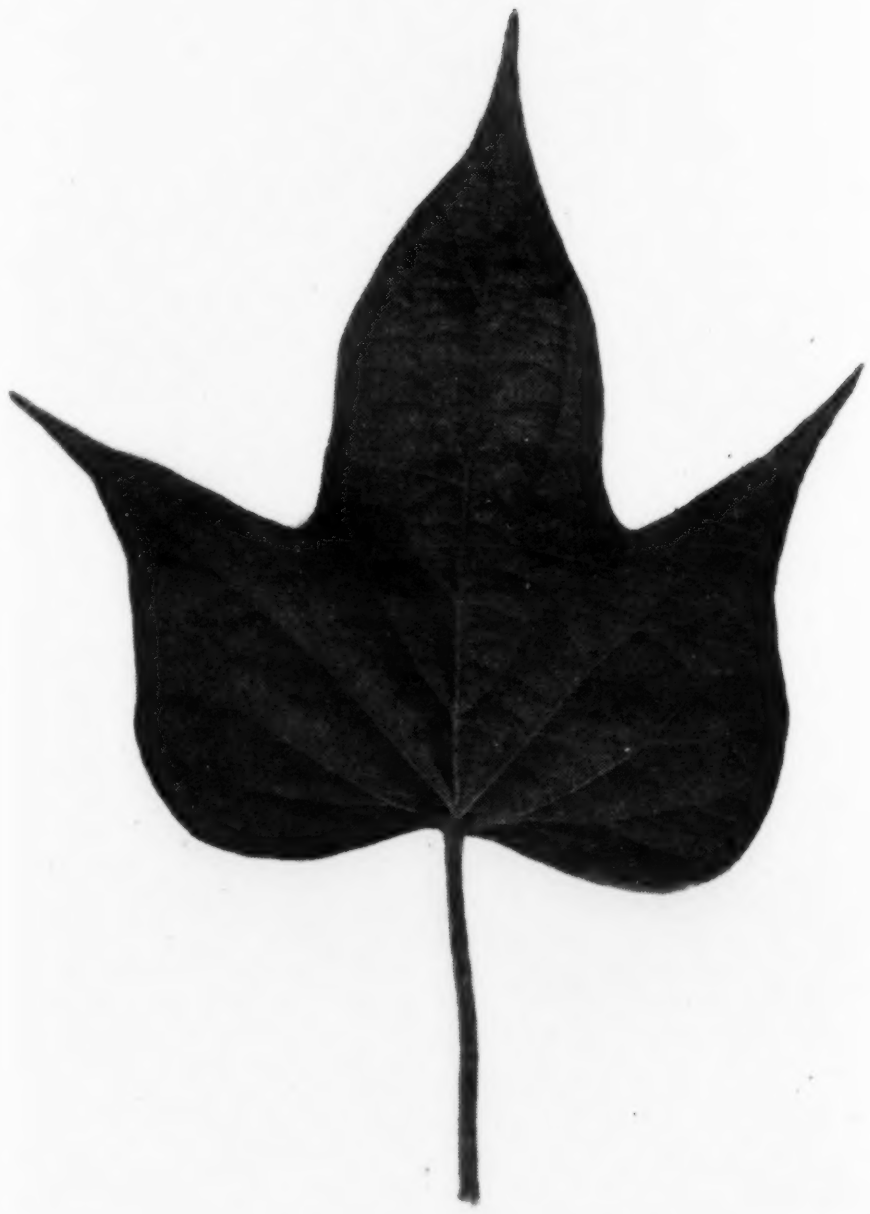
The central two plants on the foreground are shrubby. The shrubby character occurred by a sporadic mutation in an F_2 family. The others on the foreground are normal.

the linked segregation with interaxil-green, Rayed, etc., the mutant shrubby was determined to be located in the contracted chromosome.[4]

Origin of Mutations

The five new mutations above described made their appearance as recessives, according to the simple Mendelian segregation, though, in some cases, a considerable deficit of the mutant segregates was observed. The mode of their appearance shows that their mother plants, which were normal (for the mutant characters) in appearance, were heterozygous for the mutant genes. As to the origin of the mutant genes, there are the following two possibilities:

1. Mutation occurred in gametogenesis of the grand-mother plant, giving a gamete carrying



A SHRUBBY LEAF

Figure 20

The shrubby leaf has three sharp-pointed lobes with a hard texture.

a mutant gene. This mutant gamete when united with a normal gamete produced the heterozygous mother plant.

2. At fertilization or in the early stage of the embryonic development of the mother plant, a single gene mutation occurred, and the mother plant developed to be heterozygous.

The former seems more probable than the latter, though we have no definite proof to determine which represents the actual origin of the mutations.

Summary

1. Five new mutant characters, rootletless, folded, pigmy, cocoa and shrubby, are described. The mutants appeared as recessives, in accordance with a simple Mendelian ratio.

2. Rootletless has no rootlets in the early seedling stage. However, thick and crooked rootlets appear in later seedling stages. Cotyledons have shallow lobing in general. Hair covering the plant body is remarkably short.

3. The flowers of folded do not open, remaining closed all through their existence. All flowers drop off when they turn yellow, producing no fruits.

4. Pigmy is a very dwarf form. Cotyledons are small in size, curved backwards and of a deep green color. Stalks of cotyledons are very short in length. A few crumpled leaves with very short petioles appear between two cotyledons. The pigmy seedling does not grow beyond this stage.

5. Cocoa seed has approximately an intermediate color of chocolate and brown in the seed-color variations of this plant.

6. Shrubby is a mutant having a bush habit. The leaf has sharp-pointed lobes, with a hard texture.

Literature Cited

1. Hagiwara, T. 1926. Genetic studies of leaf-character in morning glories. V. *Bot. Magazine, Tokyo,* 40:226-235. (Japanese.)

2. Imai, Y. 1927. The vegetative and seminal variations observed in the Japanese morning glory, with special reference to its evolution under cultivation. *Journ. Col. Agric. Imp. Univ. Tokyo,* 9:223-274.

3. Imai, Y. 1929. The segregation of albescent seedlings and the mutation to defective seeds in a pedigree of the Japanese morning glory. *Amer. Nat.,* 63:151-159.

4. Imai, Y. 1930. Linkage studies in *Pharbitis Nil.* I. *Genetics,* 16:26-41.

5. Imai, Y. In press. The property of the genes affecting the flower colour of *Pharbitis Nil. Journ. Genetics.*

6. Imai, Y., and Tabuchi, K. 1929. Dominant mutations of the Japanese morning glory. *Amer. Nat.,* 63:362-366.

7. Miyazawa, B. 1929. On the inheritance of the "Matsushima"—variegation in the Japanese convolvulus. *Jap Journ. Genetics.* 4:167-184. (Japanese.)

Cooperation in Evolution

With the development of the nervous system, closer cooperation becomes possible and larger numbers of the advances in evolution have come about through the selection of cooperating groups rather than through the selection of individuals. This implies that the two great natural principles of struggle for existence and of cooperation are not wholly in opposition, but that each may have reacted upon the other in determining the trend of animal evolution.—Allee, W. C., *Animal Aggregations,* Page 361.